

APPENDIX 7-G

DIVERSION ADEQUACY CALCULATIONS

BEAR CANYON MINE DIVERSTION ADEQUACY CALCULATIONS

Methods

- SCS curve number technology (U.S. SCS, 1972)
- Runoff model of Hawkins and Marshall (1979)
- Channel design using Flow Master I (Haestad Methods, 1990)

Flow Calculations

The characteristics for each watershed are shown on pp. 2, 3 and 4 of this appendix. The watershed areas were determined from plates 7-1 for disturbed areas and 7-5 for undisturbed areas. The following curve numbers were used:

Undisturbed areas: Based on Pinyon - Juniper - Grass reference area measurements (Chapter 9, Appendix A of PAP):

$$\left. \begin{array}{l} \text{Veg. density} = 28.5\% \\ \text{Litter density} = 11.7\% \end{array} \right\} \quad \text{Total} = 40.2\%$$

CN = 76 (see nomograph on pg. 7-60.)

Disturbed areas: N = 90 (prof. Judgment).

A curve number of 83 was used where both disturbed and undisturbed areas exist.

Hydraulic lengths were measured from Plates 7-1 and 7-5

The average slope was determined from Plates 7-1 and 7-5, using the following equation:

$$\text{Avg. Slope} = \frac{(\text{Contour length}) (\text{Contour interval})}{\text{Watershed Area}}$$

Design storm: Use the 10-yr, 6-hr storm (temporary diversion of ephemeral drainages - see R645 - 301 - 742.333). Use 100-yr, 6-hr storm for Bear Creek (see R645-301-742.323).

$$\left. \begin{array}{l} \text{10 Yr. - 6 hr. Storm Event: } P = 1.50 \text{ in.} \\ \text{100 Yr. - 6 hr. Storm Event: } P = 2.20 \text{ in.} \end{array} \right\} \quad \text{See Miller et. Al., 1973}$$

Design storm distribution — SCS Type B.

It should be noted that historically the culverts in Bear Creek were approved for the 10 yr - 6 hr storm event, so some existing culverts were designed, approved and installed based on this design. For this reason, the 10 yr - 6 hr storm design has been shown in the calculations for informational purposes. The proposed culvert for the No. 3 Mine Access Road has been designed for the 100 year, 6-hour storm event.

WATERSHED CHARACTERISTICS

Disturbed Areas

P = 1.5"

<u>Watershed</u>	<u>CN</u>	<u>Area (Ac.)</u>	<u>Slope y (%)</u>	<u>Hyd length 1 (ft.)</u>	<u>1000 S=-10 CN</u>	<u>$l^8(s+1)^7$</u>	<u>T=1.67L Time of Conc (hr)</u>
AD-1A	76	3.70	66	1,300	3.16	0.050	0.090
AD-1B	76	2.12	95.5	520	3.16	0.022	0.037
AD-2A	76	0.97	72	440	3.16	0.020	0.040
AD-2B	83	1.08	59	320	2.05	0.015	0.025
AD-2C	83	0.25	64	140	2.05	0.007	0.012
AD-3A	76	1.49	70	400	3.16	0.021	0.034
AD-3B	76	0.78	71	400	3.16	0.020	0.034
AD-4	83	0.08	49	100	2.05	0.007	0.011
AD-5	76	2.13	73	760	3.16	0.034	0.056
AD-6	90	1.39	1.7	720	1.11	0.131	0.220
AD-7	90	2.95	8.0	1,130	1.11	0.087	0.145
AD-8 upper	90	0.70	70	400	1.11	0.013	0.021
AD-8 lower	90	2.79	1.0	600	1.11	0.148	0.247
AD-9	90	0.35	7.2	420	1.11	0.042	0.069
AD-10 upper	90	0.30	34	320	1.11	0.015	0.026
AD-10 lower	90	0.65	2.0	220	1.11	0.047	0.078
AD-11	95	0.69	20	110	0.53	0.007	0.011
AD-12 upper	90	0.22	64	340	1.11	0.012	0.020
AD-12 lower	90	0.34	8.0	500	1.11	0.045	0.076
AD-13	91	1.78	8.0	800	0.99	0.063	0.106
AD-14	90	0.08	61	120	1.11	0.005	0.009
AD-15	90	1.83	10.5	530	1.11	0.041	0.069
AD-16*	90	0.77	22	303	1.11	0.018	0.030
AD-17*	90	0.24	27	190	1.11	0.011	0.019
AD-18	90	0.9	3.2	771	1.11	0.102	0.170
AD-19*	90	0.15	49.24	109	1.11	0.005	0.009
AD-20*	90	0.47	30.48	204	1.11	0.0113	0.019

*Areas AD-16, AD-17 and AD-19 are ASCA areas treated by alternate sediment controls.

WATERSHED CHARACTERISTICS
 Undisturbed Areas
 and ASCA Areas Not Reporting To Sediment Pond

<u>Watershed</u>	<u>CN</u>	<u>Area (Ac.)</u>	<u>Slope y (%)</u>	<u>Hyd length 1 (ft.)</u>	<u>1000 S=-10 CN</u>	<u>$L=1900Y^5$</u>	<u>P = 1.5"</u> <u>T=1.67L</u> <u>Time of Conc (hr)</u>
AU-1	76	6.46	57	1,240	3.16	0.056	0.094
AU-1A	83	1.36	65	460	2.05	0.019	0.032
AU-1B	83	1.16	59	330	2.05	0.015	0.026
AU-1C	76	16.40	72	1,950	3.16	0.072	0.120
AU-2	76	2.23	62	975	3.16	0.045	0.075
AU-2A	76	1.64	63	1,025	3.16	0.046	0.077
AU-2B	76	3.80	63	1,100	3.16	0.049	0.081
AU-3	76	3.87	65	1,060	3.16	0.047	0.078
AU-3A	76	0.30	64	140	3.16	0.009	0.016
AU-4	76	7.97	63	1,300	3.16	0.056	0.093
AU-4A	83	0.92	52	357	2.05	0.018	0.029
AU-5	76	20.14	77.3	1,700	3.16	0.062	0.104
AU-6	76	2.73	70.0	780	3.16	0.035	0.059
AU-7	76	13.46	69.4	1,400	3.16	0.056	0.094
AU-8	76	4.95	85.7	720	3.16	0.030	0.050
AU-9	76	4.77	64.8	1,440	3.16	0.060	0.100
AU-10	76	35.52	76.1	2,380	3.16	0.082	0.137
AU-11	76	0.62	73.0	570	3.16	0.027	0.045
AU-12	76	2.33	44.1	480	3.16	0.030	0.050
AU-13	76	0.66	77.5	240	3.16	0.013	0.022
AU-14	76	2.43	66.7	620	3.16	0.030	0.050
AU-15	76	0.91	15.6	300	3.16	0.035	0.058
AU-16	76	44.93	71.0	2,580	3.16	0.091	0.152
AU-17	76	30.10	71.0	2,580	3.16	0.091	0.152
AU-18	76	36.55	71.0	2,580	3.16	0.091	0.152
AU-19	76	36.03	60.5	2,190	3.16	0.086	0.144
AU-20	76	20.55	57.6	1,880	3.16	0.078	0.131
AU-21	76	9.45	48.4	1,360	3.16	0.066	0.110
AU-22	76	12.05	60.3	1,120	3.16	0.051	0.084

WATERSHED CHARACTERISTICS (Con't)

Undisturbed Areas
and ASCA Areas Not Reporting To Sediment Pond

P = 1.5"

<u>Watershed</u>	<u>CN</u>	<u>Area (Ac.)</u>	<u>Slope y (%)</u>	<u>Hyd length l (ft.)</u>	<u>1000 S=-10 CN</u>	<u>$I^8(s+1)^7$ $L=1900Y^5$</u>	<u>T=1.67L</u> <u>Time of Conc (hr)</u>
AU-23	76	6.59	46.	1,500	3.16	0.073	0.122
AU-24	76	13.92	59.3	1,710	3.16	0.072	0.119
AU-25	76	2.27	46.1	980	3.16	0.052	0.087
AU-26	76	0.63	50.6	310	3.16	0.020	0.033
AU-27	76	0.2	33.6	190	3.16	0.016	0.027
AU-28	76	0.64	49.3	310	3.16	0.020	0.033
AU-29	76	1.29	40.1	190	3.16	0.015	0.025
AU-29A	76	0.55	53.4	200	3.16	0.014	0.023
AU-30	76	0.49	49.5	265	3.16	0.018	0.029
AU-31	76	2.21	63.6	570	3.16	0.029	0.048
AU-32	76	1.84	81.2	460	3.16	0.021	0.036
AU-33	76	0.71	64.3	460	3.16	0.024	0.040
AU-34	76	1.84	71.0	560	3.16	0.027	0.045
AU-35	76	0.2	56.6	320	3.16	0.019	0.032
AU-36	76	0.75	56.3	310	3.16	0.019	0.031
AU-37	76	139.82	60.3	3,250	3.16	0.119	0.198
AU-38	76	8.97	75.3	1,480	3.16	0.057	0.094
AU-39	76	1.26	75.1	630	3.16	0.029	0.048
AU-40	76	197.5	62.8	5,210	3.16	0.169	0.283
AU-41	76	11.59	62.3	1,420	3.16	0.060	0.100
AU-42	76	4.24	46.1	10	3.16	0.001	0.002
AU-43	76	13.7	71.2	1,440	3.16	0.057	0.095
Bear Creek	76	1,728	58.1	12,800	3.16	0.362	0.604

Summary of Peak Flows for 10-year, 6-hour storm P=1.5"
 (SCS type B distribution)

<u>Watershed</u>	<u>Peak Q (cfs.)</u>	<u>Watershed</u>	<u>Peak Q (cfs)</u>	<u>Watershed</u>	<u>Peak Q (cfs)</u>
AD-1A	0.48	AU-1B	0.44	AU-23	0.78
AD-1B	0.32	AU-1B	0.44	AU-24	1.66
AD-2A	0.15	AU-1C	1.95	AU-25	0.30
AD-2B	0.41	AU-2	0.30	AU-26	0.10
AD-2C	0.10	AU-2A	0.22	AU-27	0.03
AD-3A	0.23	AU-2B	0.50	AU-28	0.10
AD-3B	0.12	AU-3	0.52	AU-29	0.29
AD-4	0.03	AU-3A	0.05	AU-29A	0.67
AD-5	0.30	AU-4	1.02	AU-30	0.08
AD-6	0.81	AU-4A	0.35	AU-31	0.32
AD-7	1.83	AU-5	2.51	AU-32	0.28
AD-8 upper	0.48	AU-6	0.39	AU-33	0.11
AD-8 lower	1.59	AU-7	1.72	AU-34	0.27
AD-9	0.23	AU-8	0.72	AU-35	0.13
AD-10 upper	0.20	AU-9	0.60	AU-36	0.12
AD-10 lower	0.42	AU-10	4.05	AU-37	13.64
AD-11	0.65	AU-11	0.09	AU-38	1.15
AD-12 upper	0.15	AU-12	0.34	AU-39	0.18
AD-12 lower	0.22	AU-13	0.10	AU-40	15.96
AD-13	1.23	AU-14	0.35	AU-41	1.46
AD-14	0.05	AU-15	0.13	AU-42	0.67
AD-15	1.20	AU-16	4.92	AU-43	1.75
AD-16	1.24	AU-17	3.29	BEAR CREEK	108.18
AD-17	0.16	AU-18	4.00	BEAR CREEK ¹	412.70
AD-18	0.55	AU-19	4.03		
AD-19	0.10	AU-20	2.37		
AU-1	0.83	AU-21	1.15		
AU-1A	0.51	AU-22	1.59		

¹Design flow for the 100 year, 6 hour storm event.

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-1A

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76.00 Time of Conc. = 0.090 hrs Area = 1.83 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.48 cfs (0.1285 iph)
At T = 2.53 hrs

INPUT SUMMARY FOR W.S.: AD-1B

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.037 hr Area = 2.12 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.32 cfs (0.1500 iph)
At T = 2.51 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-2A

STORM:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

WATERSHED:

Curve Number = 76
Time of Conc. = 0.040 hrs
Area = 0.97 Ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.15 cfs (0.1487 iph)
At T = 2.51 hrs

INPUT SUMMARY FOR W.S.: AD-2B

STORM:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

WATERSHED:

Curve Number = 83
Time of Conc. = 0.025 hr
Area = 1.08 ac

OUTPUT SUMMARY

Runoff depth = 0.3788 in
Initial Abstraction = 0.4096 in
Peak Flow = 0.41 cfs (0.1487 iph)
At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-2C

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 83 Time of Conc. = 0.012 hrs Area = 0.25 ac

OUTPUT SUMMARY

Runoff depth = 0.3788 in
Initial Abstraction = 0.4096 in
Peak Flow = 0.10 cfs (0.3820 iph)
At T = 2.50 hrs

INPUT SUMMARY FOR W.S.: AD-3A

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.034 hr Area = 1.49 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.23 cfs (0.1511 iph)
At T = 2.51 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-3B

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.034 hrs Area = 0.78 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.12 cfs (0.1511 iph)
At T = 2.51 hrs

INPUT SUMMARY FOR W.S.: AD-4

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 83 Time of Conc. = 0.011 hr Area = .08 ac

OUTPUT SUMMARY

Runoff depth = 0.3788 in
Initial Abstraction = 0.4096 in
Peak Flow = 0.03 cfs (0.3824 iph)
At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-5

STORM:

WATERSHED:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

Curve Number = 76.00
Time of Conc. = 0.056 hrs
Area = 2.13 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.30 cfs (0.1416 iph)
At T = 2.52 hrs

INPUT SUMMARY FOR W.S.: AD-6

STORM:

WATERSHED:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

Curve Number = 90
Time of Conc. = 0.220 hr
Area = 1.39 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in
Initial Abstraction = 0.2222 in
Peak Flow = 0.81 cfs (0.5794 iph)
At T = 2.55 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-7

STORM:

WATERSHED:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

Curve Number = 90
Time of Conc. = 0.145 hrs
Area = 2.95 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in
Initial Abstraction = 0.2222 in
Peak Flow = 1.83 cfs (0.6152 iph)
At T = 2.53 hrs

INPUT SUMMARY FOR W.S.: AD-8 UPPER

STORM:

WATERSHED:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

Curve Number = 90
Time of Conc. = 0.021 hr
Area = 0.70 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in
Initial Abstraction = 0.2222 in
Peak Flow = 0.48 cfs (0.6732 iph)
At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-8 LOWER

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 90 Time of Conc. = 0.247 hrs Area = 2.79 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in
Initial Abstraction = 0.2222 in
Peak Flow = 1.59 cfs (0.5668 iph)
At T = 2.57 hrs

INPUT SUMMARY FOR W.S.: AD-9

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 90 Time of Conc. = 0.069 hr Area = .35 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in
Initial Abstraction = 0.2222 in
Peak Flow = 0.23 cfs (0.6513 iph)
At T = 2.51 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-10 UPPER

STORM:

WATERSHED:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

Curve Number = 90
Time of Conc. = 0.026 hrs
Area = 0.30 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in
Initial Abstraction = 0.2222 in
Peak Flow = 0.20 cfs (0.6722 iph)
At T = 2.50 hrs

INPUT SUMMARY FOR W.S.: AD-10 LOWER

STORM:

WATERSHED:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

Curve Number = 90
Time of Conc. = 0.078 hr
Area = .65 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in
Initial Abstraction = 0.2222 in
Peak Flow = 0.42 cfs (0.6473 iph)
At T = 2.51 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-11

STORM:

WATERSHED:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

Curve Number = 95
Time of Conc. = 0.011 hrs
Area = 0.69 ac

OUTPUT SUMMARY

Runoff depth = 1.0126 in
Initial Abstraction = 0.1053 in
Peak Flow = 0.65 cfs (0.9329 iph)
At T = 2.50 hrs

INPUT SUMMARY FOR W.S.: AD-12 UPPER

STORM:

WATERSHED:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

Curve Number = 90
Time of Conc. = 0.020 hr
Area = 0.22 ac

OUTPUT SUMMARY

Runoff depth = 0.68346 in
Initial Abstraction = 0.22222 in
Peak Flow = 0.15 cfs (0.6743 iph)
At T = 2.53 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-12 LOWER

STORM:

WATERSHED:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

Curve Number = 90
Time of Conc. = 0.076 hrs
Area = 0.34 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in
Initial Abstraction = 0.2222 in
Peak Flow = 0.22 cfs (0.6480 iph)
At T = 2.51 hrs

INPUT SUMMARY FOR W.S.: AD-13

STORM:

WATERSHED:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

Curve Number = 91
Time of Conc. = 0.106 hr
Area = 1.78 ac

OUTPUT SUMMARY

Runoff depth = 0.7401 in
Initial Abstraction = 0.1978 in
Peak Flow = 1.23 cfs (0.6870 iph)
At T = 2.52 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-14

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 90 Time of Conc. = 0.009 hrs Area = 0.08 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in Initial Abstraction = 0.2222 in Peak Flow = 0.05 cfs (0.6792 iph) At T = 2.50 hrs

INPUT SUMMARY FOR W.S.: AD-15

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 90 Time of Conc. = 0.069 hr Area = 1.83 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in Initial Abstraction = 0.2222 in Peak Flow = 1.20 cfs (0.6506 iph) At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-16

STORM:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

WATERSHED:

Curve Number = 90
Time of Conc. = 0.030 hr
Area = 1.83 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in
Initial Abstraction = 0.2222 in
Peak Flow = 1.24 cfs (0.6708 iph)
At T = 2.50 hrs

INPUT SUMMARY FOR W.S.: AD-17

STORM:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

WATERSHED:

Curve Number = 90
Time of Conc. = 0.019 hr
Area = 0.24 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in
Initial Abstraction = 0.2222 in
Peak Flow = 0.16 cfs (0.6743 iph)
At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-18

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 90 Time of Conc. = 0.170 hr Area = 0.90 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in Initial Abstraction = 0.2222 in Peak Flow = 0.55 cfs (0.6037 iph) At T = 2.54 hrs

INPUT SUMMARY FOR W.S.: AD-19

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 90 Time of Conc. = 0.009 hr Area = 0.15 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in Initial Abstraction = 0.2222 in Peak Flow = 0.10 cfs (0.6793 iph) At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-20

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 90 Time of Conc. = 0.019 hr Area = 0.47 ac

OUTPUT SUMMARY

Runoff depth = 0.6835 in
Initial Abstraction = 0.2222 in
Peak Flow = 0.32 cfs (0.6743 iph)
At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-1

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.094 hr Area = 6.46 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.83 cfs (0.1270 iph)
At T = 2.53 hrs

INPUT SUMMARY FOR W.S.: AU-1A

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 83 Time of Conc. = 0.032 hr Area = 1.36 ac

OUTPUT SUMMARY

Runoff depth = 0.3788 in
Initial Abstraction = 0.4096 in
Peak Flow = 0.51 cfs (0.3723 iph)
At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-1B

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 83 Time of Conc. = 0.026 hr Area = 1.16 ac

OUTPUT SUMMARY

Runoff depth = 0.3788 in Initial Abstraction = 0.4096 in Peak Flow = 0.44 cfs (0.3753 iph) At T = 2.50 hrs

INPUT SUMMARY FOR W.S.: AU-1C

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.120 hr Area = 16.40 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in Initial Abstraction = 0.6316 in Peak Flow = 1.95 cfs (0.1180 iph) At T = 2.54 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-2

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.075 hr Area = 2.23 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.30 cfs (0.1345 iph)
At T = 2.52 hrs

INPUT SUMMARY FOR W.S.: AU-2A

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.077 hr Area = 1.64 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.22 cfs (0.1332 iph)
At T = 2.53 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-2B

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.081 hr Area = 3.80 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in Initial Abstraction = 0.6316 in Peak Flow = 0.50 cfs (0.1317 iph) At T = 2.53 hrs

INPUT SUMMARY FOR W.S.: AU-3

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.078 hr Area = 3.87 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in Initial Abstraction = 0.6316 in Peak Flow = 0.52 cfs (0.1327 iph) At T = 2.53 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-3A

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.016 hr Area = 0.30 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.05 cfs (0.1597 iph)
At T = 2.50 hrs

INPUT SUMMARY FOR W.S.: AU-4

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.093 hr Area = 7.97 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 1.02 cfs (0.1273 iph)
At T = 2.53 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-4A

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 83 Time of Conc. = 0.029 hr Area = 0.92 ac

OUTPUT SUMMARY

Runoff depth = 0.3788 in
Initial Abstraction = 0.4096 in
Peak Flow = 0.35 cfs (0.3728 iph)
At T = 2.50 hrs

INPUT SUMMARY FOR W.S.: AU-5

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.104 hr Area = 20.14 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 2.51 cfs (0.1236 iph)
At T = 2.54 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-6

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.059 hr Area = 2.73 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.39 cfs (0.1404 iph)
At T = 2.51 hrs

INPUT SUMMARY FOR W.S.: AU-7

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.094 hr Area = 13.46 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 1.72 cfs (0.1270 iph)
At T = 2.53 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-8

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.050 hr Area = 4.95 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.72 cfs (0.1444 iph)
At T = 2.51 hrs

INPUT SUMMARY FOR W.S.: AU-9

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.100 hr Area = 4.77 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.60 cfs (0.1248 iph)
At T = 2.53 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-10

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.137 hr Area = 35.52 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 4.05 cfs (0.1130 iph)
At T = 2.56 hrs

INPUT SUMMARY FOR W.S.: AU-11

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.045 hr Area = 0.62 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.09 cfs (0.1464 iph)
At T = 2.51 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-12

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.050 hr Area = 2.33 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.34 cfs (0.1444 iph)
At T = 2.51 hrs

INPUT SUMMARY FOR W.S.: AU-13

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.022 hr Area = 0.66 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.10 cfs (0.1567 iph)
At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-14

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.050 hr Area = 2.43 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.35 cfs (0.1444 iph)
At T = 2.51 hrs

INPUT SUMMARY FOR W.S.: AU-15

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.058 hr Area = 0.91 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.13 cfs (0.1410 iph)
At T = 2.51 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-16

STORM:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

WATERSHED:

Curve Number = 76
Time of Conc. = 0.152 hr
Area = 44.93 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 4.92 cfs (0.1086 iph)
At T = 2.57 hrs

INPUT SUMMARY FOR W.S.: AU-17

STORM:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

WATERSHED:

Curve Number = 76
Time of Conc. = 0.152 hr
Area = 30.10 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 3.29 cfs (0.1086 iph)
At T = 2.57 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-18

STORM:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

WATERSHED:

Curve Number = 76
Time of Conc. = 0.152 hr
Area = 36.55 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 4.00 cfs (0.1086 iph)
At T = 2.57 hrs

INPUT SUMMARY FOR W.S.: AU-19

STORM:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

WATERSHED:

Curve Number = 76
Time of Conc. = 0.144 hr
Area = 36.03 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 4.03 cfs (0.1273 iph)
At T = 2.57 hr

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-20

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.131 hr Area = 20.55 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 2.37 cfs (0.1146 iph)
At T = 2.55 hrs

INPUT SUMMARY FOR W.S.: AU-21

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.110 hr Area = 9.45 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 1.15 cfs (0.1212 iph)
At T = 2.54 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-22

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.084 hr Area = 12.05 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 1.59 cfs (0.1305 iph)
At T = 2.53 hrs

INPUT SUMMARY FOR W.S.: AU-23

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.122 hr Area = 6.59 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.78 cfs (0.1213 iph)
At T = 2.55 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-23A

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.033 hr Area = 0.28 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.04 cfs (0.1513 iph)
At T = 2.51 hrs

INPUT SUMMARY FOR W.S.: AU-24

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.119 hr Area = 13.92 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 1.66 cfs (0.1182 iph)
At T = 2.55 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-25

STORM:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

WATERSHED:

Curve Number = 76
Time of Conc. = 0.087 hr
Area = 2.27 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.30 cfs (0.1296 iph)
At T = 2.53 hrs

INPUT SUMMARY FOR W.S.: AU-26

STORM:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

WATERSHED:

Curve Number = 76
Time of Conc. = 0.033 hr
Area = 0.63 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.10 cfs (0.1516 iph)
At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-27

STORM:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

WATERSHED:

Curve Number = 76
Time of Conc. = 0.027 hr
Area = 0.20 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.03 cfs (0.1541 iph)
At T = 2.51 hrs

INPUT SUMMARY FOR W.S.: AU-28

STORM:

Distribution = SCS Type 'B'
Precip. Depth = 1.50 in
Duration = 6.00 hr

WATERSHED:

Curve Number = 76
Time of Conc. = 0.033 hr
Area = 0.64 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.10 cfs (0.1516 iph)
At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-28A

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.071 hr Area = 0.99 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.14 cfs (0.1359 iph)
At T = 2.52 hrs

INPUT SUMMARY FOR W.S.: AU-29

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.025 hr Area = 1.83 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.29 cfs (0.1558 iph)
At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-29A

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.023 hr Area = 4.24 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.67 cfs (0.1564 iph)
At T = 2.50 hrs

INPUT SUMMARY FOR W.S.: AU-30

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.029 hr Area = 0.49 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.08 cfs (0.1534 iph)
At T = 2.51 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-31

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.048 hr Area = 2.21 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.32 cfs (0.1451 iph)
At T = 2.51 hrs

INPUT SUMMARY FOR W.S.: AU-32

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.036 hr Area = 1.84 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.28 cfs (0.1505 iph)
At T = 2.51 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-33

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.040 hr Area = 0.71 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.11 cfs (0.1487 iph)
At T = 2.51 hrs

INPUT SUMMARY FOR W.S.: AU-34

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.045 hr Area = 1.84 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.27 cfs (0.1464 iph)
At T = 2.51 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-35

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.032 hr Area = 0.82 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.13 cfs (0.1525 iph)
At T = 2.50 hrs

INPUT SUMMARY FOR W.S.: AU-36

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.031 hr Area = 0.75 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.12 cfs (0.1528 iph)
At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-37

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.198 hr Area = 139.82 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 13.64 cfs(0.0967 iph)
At T = 2.61 hrs

INPUT SUMMARY FOR W.S.: AU-38

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.094 hr Area = 8.94 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 1.15 cfs (0.1270 iph)
At T = 2.53 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-39

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.048 hr Area = 1.26 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.18 cfs (0.1451 iph)
At T = 2.51 hrs

INPUT SUMMARY FOR W.S.: AU-40

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.283 hr Area = 197.50 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 15.96 cfs(0.0801 iph)
At T = 2.68 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-41

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.100 hr Area = 11.59 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 1.46 cfs (0.1248 iph)
At T = 2.53 hrs

INPUT SUMMARY FOR W.S.: AU-42

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.002 hr Area = 4.24 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.67 cfs (0.1574 iph)
At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-43

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.095 hr Area = 13.70 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 1.75 cfs (0.1267 iph)
At T = 2.53 hrs

INPUT SUMMARY FOR W.S.: BEAR CREEK

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 1.50 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.604 hr Area = 1,728.00 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 108.18 cfs (0.0621 iph)
At T = 3.30 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: BEAR CREEK, 100 yr - 6 hr Storm Event

STORM:	WATERSHED:
Distribution = SCS Type 'B' Precip. Depth = 2.20 in Duration = 6.00 hr	Curve Number = 76 Time of Conc. = 0.604 hr Area = 1,728.00 ac

OUTPUT SUMMARY

Runoff depth = 0.5205 in
Initial Abstraction = 0.6316 in
Peak Flow = 412.70 cfs (0.2369 iph)
At T = 2.90 hrs

CULVERT CHARACTERISTICS

Culvert	Dia (in.)	Type	Contributing Watersheds	Peak Q(cfs)	Slope (ft/ft)	Outlet Condition
C-1U	30	CMP Flexible	AU-3, AU-4, AU-4A, AU-5	4.40 0.73	0.12 0.73	Bedrock
C-2U	12	stl pipe	AU-11	0.09	0.08	soil
C-3U	12	CMP	AU-6, AU-7, AU-11	2.20	0.05	4" rip-rap
C-4U	12	CMP	AU-8, AU-9	1.32	0.05	Soil
C-5U	12	CMP	AU-8, AU-9, AU-15	1.45	0.05	Soil
C-6U	12	CMP	AU-6, AU-7, AU-11 AU-13, AU-14	2.65	0.05	4" rip-rap
C-7U	12	CMP	AU-12	0.34	0.05	6" rip-rap
C-8U	18	Flexible CMP, RCP	AU-3, AU-3A AU-4, AU-4A, AU-5	4.45	0.13	12" rip-rap
C-9U	60	stl pipe	Bear Creek	108.18	0.06	48" rip-rap
C-10U	60	RCP	Bear Creek	108.18	0.06	48" rip-rap
C-11U	18	CMP	AU-16	4.92	0.10	6" rip-rap
C-12U	24	CMP	AU-17	3.29	0.04	6" rip-rap
C-13U C-13aU	15	CMP	misc. road drainage	1.00	0.06	Soil
C-14U	60	CMP	Bear Creek	108.18	0.06	48" rip-rap
C-15U	18	CMP flexible	AU-1B, AU-2 AU-2A, AU-2B	1.46 0.78	0.05 0.78	27" rip-rap
C-16U	15	CMP flexible	AU-1, AU-1A	1.34 0.80	0.05 0.80	Bedrock
C-17U	12	CMP	AU-1	0.83	0.18	3" rip-rap
C-18U	15	CMP flexible	AU-2	0.30 0.75	0.05 0.75	10" rip-rap
C-19U	15	CMP flexible	AU-2A	0.22 0.75	0.05 0.75	9" rip-rap
C-20U	15	CMP flexible	AU-2B	0.50 0.75	0.05 0.75	15" rip-rap

Culvert	Dia (in.)	Type	Contributing Watersheds	Peak Q(cfs)	Slope (ft/ft)	Outlet Condition
C-21U	36	CMP	Right Fork Drainage	43.09	0.06	12" rip-rap
C-22U	20	CMP	AU-19, AU-25	4.33	0.06	4"rip-rap
C-23U	36	CMP	AU-36, AU-35,AU-34, AU-20, AU-26, C-24U	38.80	0.06	11" rip-rap
C-24U	32	CMP	AU-40, C-25U	35.81	0.06	10" rip-rap
C-25U	30	CMP	AD-17, C-26U	19.85	0.06	8" rip-rap
C-26U	30	CMP	AU-39, AU-32, AU-33, C-30U, C-34U	19.69	0.06	8" rip-rap
C-27U	15	CMP	AU-22, AU-28, AU-29A, AU-31	2.68	0.06	4" rip-rap
C-28U	15	CMP	AU-34, C-29U	3.04	0.06	4" rip-rap
C-29U	15	CMP	AU-20, AU-25, AU-26,	2.77	0.06	3: rip-rap
C-30U	15	CMP	AU-21, AU-27, AU-30	1.26	0.06	soil
C-31U	12	CMP	AU-29	0.29	0.06	soil
C-32U	15	CMP	AU-22, AU-28, AU-29A	2.36	0.06	3" rip-rap
C-33U	24	CMP	AU-23, AU-37	14.42	0.06	8" rip-rap
C-34U	24	CMP	AD-19, AU-31, AU-37, AU-38, C-31U, C-32U	17.86	0.06	8" rip-rap
C-35U	84	CMP	BEAR CREEK	412.70	0.06	48" rip-rap
C-36U	15	CMP	AU-27,AU-21	1.18	0.11	3" rip-rap
C-37U	15	CMP	Abandoned In Place			
C-38U	15	CMP	AU-28	0.09	0.08	soil
C-39U	15	CMP	AU-22,AU23A,C40U	2.27	0.18	6"rip-rap
C-40U	12	CMP	AU-23	0.64	0.001	soil

CULVERT CHARACTERISTICS (con't)

Culvert	Dia (in.)	Type	Contributing Watersheds	Peak Q(cfs)	Slope (ft/ft)	Outlet Condition
C-1D	15	CMP, flexible	AD-6, AD-3B	0.93	1.00	24" rip-rap
C-2D	15	CMP, RCP, flexible	AD-2B, AD-2C, AD-3B, AD-4, AD-6	1.47	0.40	10" rip-rap
C-3D	20	stl pipe	AD-3A	0.23	0.03	4" rip-rap
C-4D	21	CMP	AD-3A, AD-5 AD-7, AD14, C-10D	2.66	0.18	9" rip-rap
C-5D	18	CMP	AD-9	0.23	0.08	soil
C-6D	12	CMP	AD-10	0.62	0.48	9" rip-rap
C-7D	18	CMP	Abandoned In Place			
C-8D	18	CMP	AD-3A, AD-5 AD-7	2.36	0.05	3" rip-rap
C-9D	18	CMP	See C-8D	2.36	0.05	3" rip-rap
C-10D	18	CMP	TIPPLE WASH HOSE	0.25	0.03	soil
C-11D	12	CMP flexible	AU-4A	0.35 0.25	0.05 0.25	3" rip-rap
C-12D	8	CMP	AD-18	0.55	0.05	soil

All culverts were evaluated for adequacy using Flowmaster (Haestad Methods, Inc.).

The flow to culverts were taken as the summation of flows from each contributing watershed (not accounting for flow routing). Thus, assumed flows are conservatively high.

Assume — $\eta = .024$ for CMP & flexible culverts

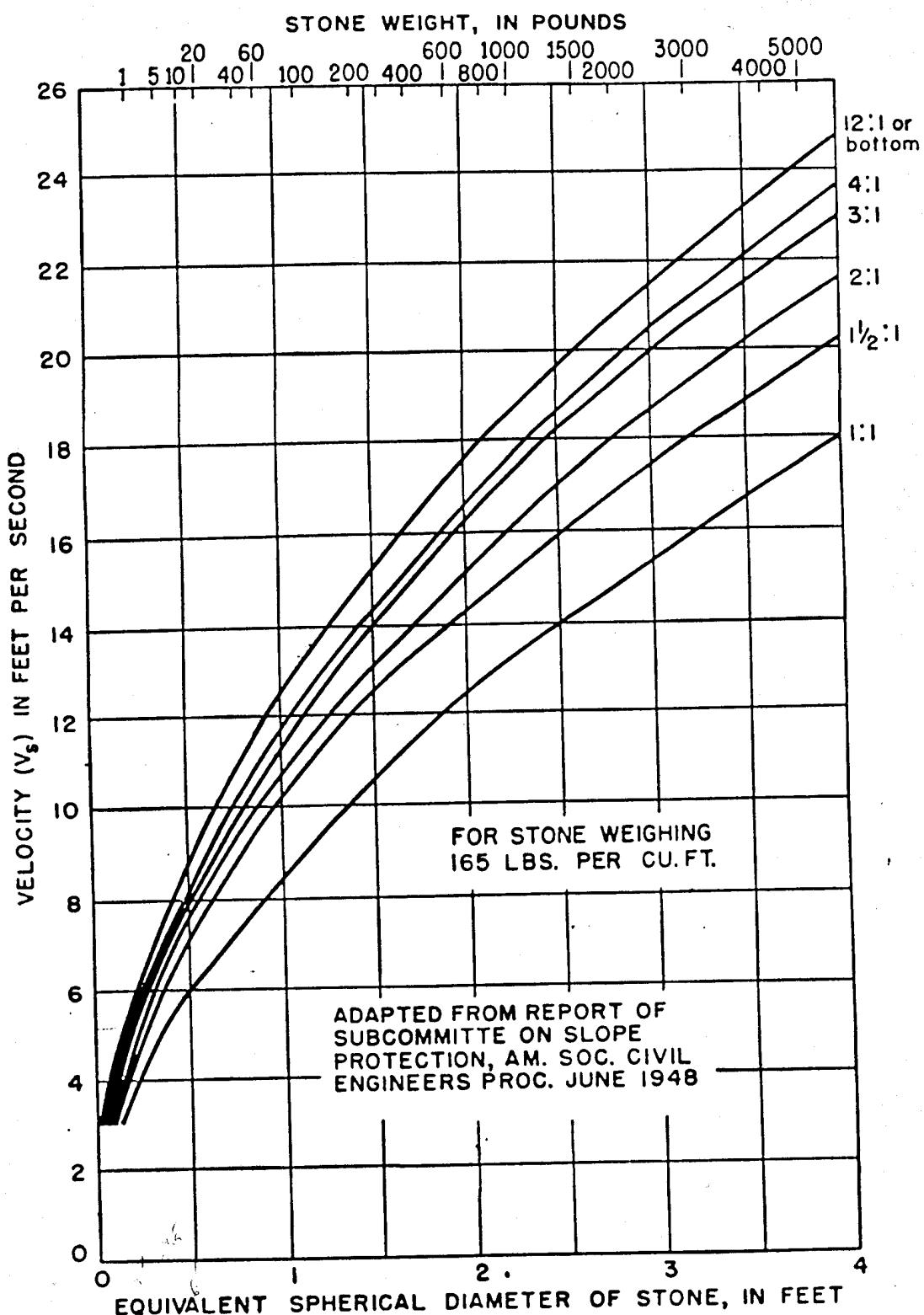
$\eta = .015$ for RCP & Steel pipe

Flowmaster printouts are shown on the following pages.

All culverts are designed to pass the design flows without overtopping. Comparisons of outlet velocity with channel stability were made using the figure on page 53. The maximum permissible velocity corresponding to the appropriate channel slopes were used (1:1, 2:1 etc.).

Velocities of 5.0 ft/s and less were considered non-erosive.

Where riprap is to be placed at the culvert outlet, it should extend a minimum distance of 3D₅₀ - 5D₅ downstream from the culvert outlet. The required riprap for each culvert is shown in the tables on pg. 49-51.



Size of Stone that will Resist Displacement for Various Velocities and Slide Slope (U.S. Department of Transportation, 1978).

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-1U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.730 ft/ft 000
Diameter	30 in
Discharge	4.40 cfs

Results

Depth	0.26 ft
Flow Area	0.3 ft ²
Wetted	1.65 ft
Perimeter	
Top Width	1.53 ft
Critical Depth	0.69 ft
Percent Full	10.5 %
Critical Slope	0.014104 ft/ft
Velocity	16.01 ft/s
Velocity Head	3.98 ft
Specific	4.24 ft
Energy	
Froude	6.67
Number	
Maximum	204.19 cfs
Discharge	
Discharge Full	189.82 cfs
Slope Full	0.000392 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 30" m.d. riprap at outlet

At Slope = 0.12 ft/ft, flow depth = 0.41 ft

B.C.

7G-54

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-2U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.015
Slope	0.080 ft/ft 000
Diameter	12 in
Discharge	0.09 cfs

Results

Depth	0.07 ft
Flow Area	2.5e-2 ft ²
Wetted	0.54 ft
Perimeter	
Top Width	0.52 ft
Critical Depth	0.12 ft
Percent Full	7.2 %
Critical Slope	0.008424 ft/ft
Velocity	3.60 ft/s
Velocity Head	0.20 ft
Specific	0.27 ft
Energy	
Froude	2.89
Number	
Maximum	9.39 cfs
Discharge	
Discharge Full	8.73 cfs
Slope Full	0.000008 ft/ft
Flow Type	Supercriti cal

B.C.

7G-55

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-3U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.050 ft/ft 000
Diameter	12 in
Discharge	2.20 cfs

Results

Depth	0.51 ft
Flow Area	0.4 ft ²
Wetted	1.58 ft
Perimeter	
Top Width	1.00 ft
Critical Depth	0.63 ft
Percent Full	50.6 %
Critical Slope	0.024382 ft/ft
Velocity	5.52 ft/s
Velocity Head	0.47 ft
Specific	0.98 ft
Energy	
Froude	1.54
Number	
Maximum	4.64 cfs
Discharge	
Discharge Full	4.32 cfs
Slope Full	0.012997 ft/ft
Flow Type	Supercritical

B.C.

7G-56

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-4U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.050 ft/ft 000
Diameter	12 in
Discharge	1.32 cfs

Results

Depth	0.38 ft
Flow Area	0.3 ft ²
Wetted	1.33 ft
Perimeter	
Top Width	0.97 ft
Critical Depth	0.49 ft
Percent Full	38.0 %
Critical Slope	0.020695 ft/ft
Velocity	4.83 ft/s
Velocity Head	0.36 ft
Specific	0.74 ft
Energy	
Froude	1.60
Number	
Maximum	4.64 cfs
Discharge	
Discharge Full	4.32 cfs
Slope Full	0.004679 ft/ft
Flow Type	Supercritical

B.C.

7G-57

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-5U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.050 ft/ft 000
Diameter	12 in
Discharge	1.45 cfs

Results

Depth	0.40 ft
Flow Area	0.3 ft ²
Wetted	1.37 ft
Perimeter	
Top Width	0.98 ft
Critical Depth	0.51 ft
Percent Full	39.9 %
Critical Slope	0.021111 ft/ft
Velocity	4.95 ft/s
Velocity Head	0.38 ft
Specific	0.78 ft
Energy	
Froude	1.60
Number	
Maximum	4.64 cfs
Discharge	
Discharge Full	4.32 cfs
Slope Full	0.005646 ft/ft
Flow Type	Supercritical

B.C.

7G-58

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-6U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.050 ft/ft 000
Diameter	12 in
Discharge	2.65 cfs

Results

Depth	0.57 ft
Flow Area	0.5 ft ²
Wetted	1.70 ft
Perimeter	
Top Width	0.99 ft
Critical Depth	0.70 ft
Percent Full	56.6 %
Critical Slope	0.027137 ft/ft
Velocity	5.77 ft/s
Velocity Head	0.52 ft
Specific	1.08 ft
Energy	
Froude	1.50
Number	
Maximum	4.64 cfs
Discharge	
Discharge Full	4.32 cfs
Slope Full	0.018858 ft/ft
Flow Type	Supercritical

B.C.

7G-59

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-7U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.050 ft/ft 000
Diameter	12 in
Discharge	0.34 cfs

Results

Depth	0.19 ft
Flow Area	0.1 ft ²
Wetted	0.90 ft
Perimeter	
Top Width	0.78 ft
Critical Depth	0.24 ft
Percent Full	19.0 %
Critical Slope	0.019313 ft/ft
Velocity	3.28 ft/s
Velocity Head	0.17 ft
Specific	0.36 ft
Energy	
Froude	1.59
Number	
Maximum	4.64 cfs
Discharge	
Discharge Full	4.32 cfs
Slope Full	0.000310 ft/ft
Flow Type	Supercritical

B.C.

7G-60

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-8U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.015
Slope	0.130 ft/ft 000
Diameter	18 in
Discharge	4.45 cfs

Results

Depth	0.37 ft
Flow Area	0.3 ft ²
Wetted	1.57 ft
Perimeter	
Top Width	1.30 ft
Critical Depth	0.81 ft
Percent Full	24.9 %
Critical Slope	0.007410 ft/ft
Velocity	12.98 ft/s
Velocity Head	2.62 ft
Specific	2.99 ft
Energy	
Froude	4.45
Number	
Maximum	35.31 cfs
Discharge	
Discharge Full	32.82 cfs
Slope Full	0.002390 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 15" m.d. riprap and outlet

B.C.

7G-61

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-9U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.015
Slope	0.060 ft/ft 000
Diameter	60 in
Discharge	108.1 cfs 8

Results

Depth	1.50 ft
Flow Area	5.0 ft ²
Wetted Perimeter	5.80 ft
Top Width	4.58 ft
Critical Depth	2.97 ft
Percent Full	30.0 %
Critical Slope	0.005269 ft/ft
Velocity	21.85 ft/s
Velocity Head	7.42 ft
Specific Energy	8.92 ft
Froude	3.71
Number	
Maximum Discharge	594.72 cfs
Discharge Full	552.86 cfs
Slope Full	0.002297 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 48" m.d. riprap at outlet

B.C.

7G-62

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-10U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.015
Slope	0.060 ft/ft 000
Diameter	60 in
Discharge	108.1 cfs 8

Results

Depth	1.50 ft
Flow Area	5.0 ft ²
Wetted	5.80 ft
Perimeter	
Top Width	4.58 ft
Critical Depth	2.97 ft
Percent Full	30.0 %
Critical Slope	0.005269 ft/ft
Velocity	21.85 ft/s
Velocity Head	7.42 ft
Specific	8.92 ft
Energy	
Froude	3.71
Number	
Maximum	594.72 cfs
Discharge	
Discharge Full	552.86 cfs
Slope Full	0.002297 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 48" m.d. riprap and outlet

B.C.

7G-63

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-11U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.100 ft/ft 000
Diameter	18 in
Discharge	4.92 cfs

Results

Depth	0.54 ft
Flow Area	0.6 ft ²
Wetted	1.92 ft
Perimeter	
Top Width	1.44 ft
Critical Depth	0.85 ft
Percent Full	35.7 %
Critical Slope	0.019587 ft/ft
Velocity	8.68 ft/s
Velocity Head	1.17 ft
Specific	1.71 ft
Energy	
Froude	2.44
Number	
Maximum	19.35 cfs
Discharge	
Discharge Full	17.99 cfs
Slope Full	0.007478 ft/ft
Flow Type	Supercritical

B.C.

7G-64

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-12U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.040 ft/ft 000
Diameter	24 in
Discharge	3.29 cfs

Results

Depth	0.49 ft
Flow Area	0.6 ft ²
Wetted	2.08 ft
Perimeter	
Top Width	1.73 ft
Critical Depth	0.63 ft
Percent Full	24.7 %
Critical Slope	0.015194 ft/ft
Velocity	5.43 ft/s
Velocity Head	0.46 ft
Specific	0.95 ft
Energy	
Froude	1.62
Number	
Maximum	26.36 cfs
Discharge	
Discharge Full	24.51 cfs
Slope Full	0.000721 ft/ft
Flow Type	Supercritical

B.C.

7G-65

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-13U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	16 in
Discharge	1.00 cfs

Results

Depth	0.28 ft
Flow Area	0.2 ft ²
Wetted	1.27 ft
Perimeter	
Top Width	1.09 ft
Critical Depth	0.39 ft
Percent Full	21.2 %
Critical Slope	0.017393 ft/ft
Velocity	4.64 ft/s
Velocity Head	0.33 ft
Specific	0.62 ft
Energy	
Froude	1.84
Number	
Maximum	10.88 cfs
Discharge	
Discharge Full	10.11 cfs
Slope Full	0.000587 ft/ft
Flow Type	Supercritical

B.C.

7G-66

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-13aU
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	16 in
Discharge	1.00 cfs

Results

Depth	0.28 ft
Flow Area	0.2 ft ²
Wetted	1.27 ft
Perimeter	
Top Width	1.09 ft
Critical Depth	0.39 ft
Percent Full	21.2 %
Critical Slope	0.017380 ft/ft
Velocity	4.64 ft/s
Velocity Head	0.33 ft
Specific	0.62 ft
Energy	
Froude	1.84
Number	
Maximum	10.95 cfs
Discharge	
Discharge Full	10.18 cfs
Slope Full	0.000579 ft/ft
Flow Type	Supercritical

B.C.

7G-67

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-14U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	60 in
Discharge	108.1 cfs 8

Results

Depth	1.92 ft
Flow Area	7.0 ft ²
Wetted	6.69 ft
Perimeter	
Top Width	4.86 ft
Critical Depth	2.97 ft
Percent Full	38.4 %
Critical Slope	0.013489 ft/ft
Velocity	15.56 ft/s
Velocity Head	3.76 ft
Specific	5.69 ft
Energy	
Froude	2.30
Number	
Maximum	371.70 cfs
Discharge	
Discharge Full	345.54 cfs
Slope Full	0.005881 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 48" m.d. riprap and outlet

B.C.

7G-68

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-15U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.780 ft/ft 000
Diameter	18 in
Discharge	1.46 cfs

Results

Depth	0.18 ft
Flow Area	0.1 ft ²
Wetted	1.05 ft
Perimeter	
Top Width	0.96 ft
Critical Depth	0.45 ft
Percent Full	11.7 %
Critical Slope	0.016703 ft/ft
Velocity	12.60 ft/s
Velocity Head	2.47 ft
Specific	2.64 ft
Energy	
Froude	6.41
Number	
Maximum	54.05 cfs
Discharge	
Discharge Full	50.25 cfs
Slope Full	0.000658 ft/ft
Flow Type	Supercritical

Minimum Required riprap conditions = 27" m.d. riprap at outlet

At slope = 0.05 ft/ft, flow depth = **0.34** ft

B.C.

7G-69

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-16U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.800 ft/ft 000
Diameter	15 in
Discharge	1.34 cfs

Results

Depth	0.18 ft
Flow Area	0.1 ft ²
Wetted	0.96 ft
Perimeter	
Top Width	0.87 ft
Critical Depth	0.46 ft
Percent Full	14.1 %
Critical Slope	0.017971 ft/ft
Velocity	12.69 ft/s
Velocity Head	2.50 ft
Specific	2.68 ft
Energy	
Froude	6.42
Number	
Maximum	33.66 cfs
Discharge	
Discharge Full	31.29 cfs
Slope Full	0.001467 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 27" m.d. riprap at outlet

At slope = 0.05 ft/ft, flow depth = **0.35** ft.

B.C.

7G-70

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-17U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.180 ft/ft 000
Diameter	12 in
Discharge	0.83 cfs

Results

Depth	0.22 ft
Flow Area	0.1 ft ²
Wetted	0.96 ft
Perimeter	
Top Width	0.82 ft
Critical Depth	0.38 ft
Percent Full	21.5 %
Critical Slope	0.019427 ft/ft
Velocity	6.69 ft/s
Velocity Head	0.70 ft
Specific	0.91 ft
Energy	
Froude	3.04
Number	
Maximum	8.81 cfs
Discharge	
Discharge Full	8.19 cfs
Slope Full	0.001850 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 3" m.d. riprap at outlet

B.C.

7G-71

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-18U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.750 ft/ft 000
Diameter	15 in
Discharge	0.30 cfs

Results

Depth	0.09 ft
Flow Area	3.8e-2 ft ²
Wetted	0.67 ft
Perimeter	
Top Width	0.64 ft
Critical Depth	0.21 ft
Percent Full	7.0 %
Critical Slope	0.018728 ft/ft
Velocity	7.90 ft/s
Velocity Head	0.97 ft
Specific	1.06 ft
Energy	
Froude	5.72
Number	
Maximum	32.60 cfs
Discharge	
Discharge Full	30.30 cfs
Slope Full	0.000074 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 10" m.d. riprap at outlet

At slope = 0.05 ft/ft, flow depth = **0.17** ft.

B.C.

7G-72

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-19U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.750 ft/ft 000
Diameter	15 in
Discharge	0.22 cfs

Results

Depth	0.08 ft
Flow Area	3.1e-2 ft ²
Wetted	0.62 ft
Perimeter	
Top Width	0.60 ft
Critical Depth	0.18 ft
Percent Full	6.1 %
Critical Slope	0.019286 ft/ft
Velocity	7.20 ft/s
Velocity Head	0.80 ft
Specific	0.88 ft
Energy	
Froude	5.61
Number	
Maximum	32.60 cfs
Discharge	
Discharge Full	30.30 cfs
Slope Full	0.000040 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 9" m.d. riprap at outlet

At slope = 0.05 ft/ft, flow depth = **0.14** ft.

B.C.

7G-73

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-20U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.750 ft/ft 000
Diameter	15 in
Discharge	0.51 cfs

Results

Depth	0.11 ft
Flow Area	0.1 ft ²
Wetted	0.76 ft
Perimeter	
Top Width	0.72 ft
Critical Depth	0.28 ft
Percent Full	9.0 %
Critical Slope	0.018052 ft/ft
Velocity	9.28 ft/s
Velocity Head	1.34 ft
Specific	1.45 ft
Energy	
Froude	5.91
Number	
Maximum	32.60 cfs
Discharge	
Discharge Full	30.30 cfs
Slope Full	0.000212 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 15" m.d. riprap at outlet

At slope = 0.05 ft/ft, flow depth = **0.22** ft.

B.C.

7G-74

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-21U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	36 in
Discharge	43.09 cfs

Results

Depth	1.48 ft
Flow Area	3.5 ft ²
Wetted	4.67 ft
Perimeter	
Top Width	3.00 ft
Critical Depth	2.14 ft
Percent Full	49.2 %
Critical Slope	0.019357 ft/ft
Velocity	12.44 ft/s
Velocity Head	2.40 ft
Specific	3.88 ft
Energy	
Froude	2.04
Number	
Maximum	95.19 cfs
Discharge	
Discharge Full	88.49 cfs
Slope Full	0.014227 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 12" m.d. riprap at outlet

B.C.

7G-75

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-22U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	21 in
Discharge	4.33 cfs

Results

Depth	0.54 ft
Flow Area	0.6 ft ²
Wetted	2.06 ft
Perimeter	
Top Width	1.62 ft
Critical Depth	0.76 ft
Percent Full	30.8 %
Critical Slope	0.016559 ft/ft
Velocity	6.88 ft/s
Velocity Head	0.74 ft
Specific	1.27 ft
Energy	
Froude	1.94
Number	
Maximum	22.61 cfs
Discharge	
Discharge Full	21.02 cfs
Slope Full	0.002545 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 4" m.d. riprap at outlet

B.C.

7G-76

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-23U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	36 in
Discharge	38.80 cfs

Results

Depth	1.39 ft
Flow Area	3.2 ft ²
Wetted	4.49 ft
Perimeter	
Top Width	2.99 ft
Critical Depth	2.03 ft
Percent Full	46.3 %
Critical Slope	0.018074 ft/ft
Velocity	12.11 ft/s
Velocity Head	2.28 ft
Specific	3.67 ft
Energy	
Froude	2.06
Number	
Maximum	95.19 cfs
Discharge	
Discharge Full	88.49 cfs
Slope Full	0.011535 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 11" m.d. riprap at outlet

B.C.

7G-77

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-24U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	32 in
Discharge	35.81 cfs

Results

Depth	1.42 ft
Flow Area	3.0 ft ²
Wetted	4.36 ft
Perimeter	
Top Width	2.67 ft
Critical Depth	2.01 ft
Percent Full	53.1 %
Critical Slope	0.021893 ft/ft
Velocity	11.87 ft/s
Velocity Head	2.19 ft
Specific	3.61 ft
Energy	
Froude	1.97
Number	
Maximum	69.76 cfs
Discharge	
Discharge Full	64.85 cfs
Slope Full	0.018293 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 10" m.d. riprap at outlet

B.C.

7G-78

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-25U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	30 in
Discharge	19.85 cfs

Results

Depth	1.04 ft
Flow Area	1.9 ft ²
Wetted	3.51 ft
Perimeter	
Top Width	2.47 ft
Critical Depth	1.51 ft
Percent Full	41.8 %
Critical Slope	0.017249 ft/ft
Velocity	10.22 ft/s
Velocity Head	1.62 ft
Specific	2.67 ft
Energy	
Froude	2.03
Number	
Maximum	58.54 cfs
Discharge	
Discharge Full	54.42 cfs
Slope Full	0.007983 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 8" m.d. riprap at outlet

B.C.

7G-79

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-26U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	30 in
Discharge	19.69 cfs

Results

Depth	1.04 ft
Flow Area	1.9 ft ²
Wetted	3.50 ft
Perimeter	
Top Width	2.46 ft
Critical Depth	1.51 ft
Percent Full	41.6 %
Critical Slope	0.017190 ft/ft
Velocity	10.19 ft/s
Velocity Head	1.62 ft
Specific	2.65 ft
Energy	
Froude	2.03
Number	
Maximum	58.54 cfs
Discharge	
Discharge Full	54.42 cfs
Slope Full	0.007855 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 8" m.d. riprap at outlet

B.C.

7G-80

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-27U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	18 in
Discharge	2.68 cfs

Results

Depth	0.45 ft
Flow Area	0.4 ft ²
Wetted	1.73 ft
Perimeter	
Top Width	1.37 ft
Critical Depth	0.62 ft
Percent Full	29.7 %
Critical Slope	0.017258 ft/ft
Velocity	6.09 ft/s
Velocity Head	0.58 ft
Specific	1.02 ft
Energy	
Froude	1.89
Number	
Maximum	14.99 cfs
Discharge	
Discharge Full	13.94 cfs
Slope Full	0.002219 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 4" m.d. riprap at outlet

B.C.

7G-81

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-28U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	18 in
Discharge	3.04 cfs

Results

Depth	0.48 ft
Flow Area	0.5 ft ²
Wetted	1.79 ft
Perimeter	
Top Width	1.40 ft
Critical Depth	0.66 ft
Percent Full	31.7 %
Critical Slope	0.017514 ft/ft
Velocity	6.31 ft/s
Velocity Head	0.62 ft
Specific	1.09 ft
Energy	
Froude	1.89
Number	
Maximum	14.99 cfs
Discharge	
Discharge Full	13.94 cfs
Slope Full	0.002855 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 4" m.d. riprap at outlet

B.C.

7G-82

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-29U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	18 in
Discharge	2.77 cfs

Results

Depth	0.45 ft
Flow Area	0.5 ft ²
Wetted	1.75 ft
Perimeter	
Top Width	1.38 ft
Critical Depth	0.63 ft
Percent Full	30.2 %
Critical Slope	0.017296 ft/ft
Velocity	6.15 ft/s
Velocity Head	0.59 ft
Specific	1.04 ft
Energy	
Froude	1.89
Number	
Maximum	14.99 cfs
Discharge	
Discharge Full	13.94 cfs
Slope Full	0.002370 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 3" m.d. riprap at outlet

B.C.

7G-83

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-30U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	15 in
Discharge	1.26 cfs

Results

Depth	0.32 ft
Flow Area	0.3 ft ²
Wetted	1.34 ft
Perimeter	
Top Width	1.10 ft
Critical Depth	0.44 ft
Percent Full	25.9 %
Critical Slope	0.017902 ft/ft
Velocity	4.99 ft/s
Velocity Head	0.39 ft
Specific	0.71 ft
Energy	
Froude	1.83
Number	
Maximum	9.22 cfs
Discharge	
Discharge Full	8.57 cfs
Slope Full	0.001297 ft/ft
Flow Type	Supercritical

B.C.

7G-84

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-31U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	12 in
Discharge	0.29 cfs

Results

Depth	0.17 ft
Flow Area	0.1 ft ²
Wetted	0.84 ft
Perimeter	
Top Width	0.75 ft
Critical Depth	0.22 ft
Percent Full	16.8 %
Critical Slope	0.019390 ft/ft
Velocity	3.33 ft/s
Velocity Head	0.17 ft
Specific	0.34 ft
Energy	
Froude	1.72
Number	
Maximum	5.08 cfs
Discharge	
Discharge Full	4.73 cfs
Slope Full	0.000226 ft/ft
Flow Type	Supercritical

B.C.

7G-85

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-32U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.050 ft/ft 000
Diameter	18 in
Discharge	2.36 cfs

Results

Depth	0.44 ft
Flow Area	0.4 ft ²
Wetted	1.71 ft
Perimeter	
Top Width	1.36 ft
Critical Depth	0.58 ft
Percent Full	29.2 %
Critical Slope	0.017029 ft/ft
Velocity	5.50 ft/s
Velocity Head	0.47 ft
Specific	0.91 ft
Energy	
Froude	1.73
Number	
Maximum	13.69 cfs
Discharge	
Discharge Full	12.72 cfs
Slope Full	0.001721 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 3" m.d. riprap at outlet

B.C.

7G-86

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-33U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.024 ft/ft 000
Diameter	30 in
Discharge	15.44 cfs

Results

Depth	1.17 ft
Flow Area	2.3 ft ²
Wetted	3.77 ft
Perimeter	
Top Width	2.50 ft
Critical Depth	1.33 ft
Percent Full	46.9 %
Critical Slope	0.015847 ft/ft
Velocity	6.82 ft/s
Velocity Head	0.72 ft
Specific	1.90 ft
Energy	
Froude	1.26
Number	
Maximum	37.02 cfs
Discharge	
Discharge Full	34.42 cfs
Slope Full	0.004830 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 8" m.d. riprap at outlet

B.C.

7G-87

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-34U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	30 in
Discharge	17.86 cfs

Results

Depth	0.99 ft
Flow Area	1.8 ft ²
Wetted	3.39 ft
Perimeter	
Top Width	2.44 ft
Critical Depth	1.43 ft
Percent Full	39.4 %
Critical Slope	0.016577 ft/ft
Velocity	9.93 ft/s
Velocity Head	1.53 ft
Specific	2.52 ft
Energy	
Froude	2.04
Number	
Maximum	58.54 cfs
Discharge	
Discharge Full	54.42 cfs
Slope Full	0.006463 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 8" m.d. riprap at outlet

B.C.

7G-88

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-35U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	84 in
Discharge	412.7 cfs 0

Results

Depth	3.45 ft
Flow Area	18.9 ft ²
Wetted	10.89 ft
Perimeter	
Top Width	7.00 ft
Critical Depth	5.35 ft
Percent Full	49.2 %
Critical Slope	0.016383 ft/ft
Velocity	21.88 ft/s
Velocity Head	7.44 ft
Specific	10.88 ft
Energy	
Froude	2.35
Number	
Maximum	911.73 cfs
Discharge	
Discharge Full	847.56 cfs
Slope Full	0.014226 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 48" m.d. riprap at outlet

B.C.

7G-89

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-36U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.110 ft/ft 000
Diameter	15 in
Discharge	1.18 cfs

Results

Depth	0.27 ft
Flow Area	0.2 ft ²
Wetted	1.21 ft
Perimeter	
Top Width	1.03 ft
Critical Depth	0.43 ft
Percent Full	21.5 %
Critical Slope	0.017833 ft/ft
Velocity	6.08 ft/s
Velocity Head	0.57 ft
Specific	0.84 ft
Energy	
Froude	2.46
Number	
Maximum	12.48 cfs
Discharge	
Discharge Full	11.60 cfs
Slope Full	0.001137 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 3" m.d. riprap at outlet

B.C.

7G-90

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-37U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.310 ft/ft 000
Diameter	15 in
Discharge	1.15 cfs

Results

Depth	0.21 ft
Flow Area	0.1 ft ²
Wetted	1.05 ft
Perimeter	
Top Width	0.93 ft
Critical Depth	0.42 ft
Percent Full	16.5 %
Critical Slope	0.017835 ft/ft
Velocity	8.69 ft/s
Velocity Head	1.17 ft
Specific	1.38 ft
Energy	
Froude	4.06
Number	
Maximum	20.96 cfs
Discharge	
Discharge Full	19.48 cfs
Slope Full	0.001080 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 6" m.d. riprap at outlet

B.C.

7G-91

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-38U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.080 ft/ft 000
Diameter	15 in
Discharge	0.09 cfs

Results

Depth	0.08 ft
Flow Area	3.6e-2 ft ²
Wetted	0.66 ft
Perimeter	
Top Width	0.63 ft
Critical Depth	0.12 ft
Percent Full	6.7 %
Critical Slope	0.021173 ft/ft
Velocity	2.52 ft/s
Velocity Head	0.10 ft
Specific Energy	0.18 ft
Froude Number	1.86
Maximum Discharge	10.65 cfs
Discharge Full	9.90 cfs
Slope Full	0.000007 ft/ft
Flow Type	Supercritical

B.C.

7G-92

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-39U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.180 ft/ft 000
Diameter	15 in
Discharge	2.27 cfs

Results

Depth	0.33 ft
Flow Area	0.3 ft ²
Wetted	1.35 ft
Perimeter	
Top Width	1.10 ft
Critical Depth	0.60 ft
Percent Full	26.4 %
Critical Slope	0.019156 ft/ft
Velocity	8.75 ft/s
Velocity Head	1.19 ft
Specific	1.52 ft
Energy	
Froude	3.18
Number	
Maximum	15.97 cfs
Discharge	
Discharge Full	14.84 cfs
Slope Full	0.004209 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 6" m.d. riprap at outlet

B.C.

7G-93

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-40U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.001 ft/ft 000
Diameter	12 in
Discharge	0.64 cfs

Results

Depth	0.87 ft
Flow Area	0.7 ft ²
Wetted	2.41 ft
Perimeter	
Top Width	0.67 ft
Critical Depth	0.33 ft
Percent Full	87.2 %
Critical Slope	0.01917 ft/ft 1
Velocity	0.88 ft/s
Velocity Head	0.01 ft
Specific	0.88 ft
Energy	
Froude	0.15
Number	
Maximum	0.66 cfs
Discharge	
Discharge Full	0.61 cfs
Slope Full	0.00110 ft/ft 0
Flow Type	Subcritic al

B.C.

7G-94

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-1D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	1.000 ft/ft 000
Diameter	15 in
Discharge	0.93 cfs

Results

Depth	0.14 ft
Flow Area	0.1 ft ²
Wetted	0.85 ft
Perimeter	
Top Width	0.79 ft
Critical Depth	0.38 ft
Percent Full	11.2 %
Critical Slope	0.017750 ft/ft
Velocity	12.30 ft/s
Velocity Head	2.35 ft
Specific	2.49 ft
Energy	
Froude	7.01
Number	
Maximum	37.64 cfs
Discharge	
Discharge Full	34.99 cfs
Slope Full	0.000706 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 24" m.d. riprap at outlet

B.C.

7G-95

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-2D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.400 ft/ft 000
Diameter	15 in
Discharge	1.47 cfs

Results

Depth	0.22 ft
Flow Area	0.1 ft ²
Wetted	1.08 ft
Perimeter	
Top Width	0.95 ft
Critical Depth	0.48 ft
Percent Full	17.5 %
Critical Slope	0.018051 ft/ft
Velocity	10.22 ft/s
Velocity Head	1.62 ft
Specific	1.84 ft
Energy	
Froude	4.63
Number	
Maximum	23.80 cfs
Discharge	
Discharge Full	22.13 cfs
Slope Full	0.001765 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 10" m.d. riprap at outlet

B.C.

7G-96

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-3D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.015
Slope	0.030 ft/ft 000
Diameter	20 in
Discharge	0.23 cfs

Results

Depth	0.12 ft
Flow Area	0.1 ft ²
Wetted	0.92 ft
Perimeter	
Top Width	0.87 ft
Critical Depth	0.17 ft
Percent Full	7.4 %
Critical Slope	0.007435 ft/ft
Velocity	3.16 ft/s
Velocity Head	0.16 ft
Specific	0.28 ft
Energy	
Froude	1.93
Number	
Maximum	22.46 cfs
Discharge	
Discharge Full	20.88 cfs
Slope Full	0.000004 ft/ft
Flow Type	Supercritical

B.C.

7G-97

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-4D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.180 ft/ft 000
Diameter	21 in
Discharge	2.66 cfs

Results

Depth	0.32 ft
Flow Area	0.3 ft ²
Wetted	1.55 ft
Perimeter	
Top Width	1.35 ft
Critical Depth	0.59 ft
Percent Full	18.3 %
Critical Slope	0.015939 ft/ft
Velocity	8.83 ft/s
Velocity Head	1.21 ft
Specific	1.53 ft
Energy	
Froude	3.30
Number	
Maximum	39.17 cfs
Discharge	
Discharge Full	36.41 cfs
Slope Full	0.000961 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 9" m.d. riprap at outlet

B.C.

7G-98

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-5D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.080 ft/ft 000
Diameter	18 in
Discharge	0.23 cfs

Results

Depth	0.13 ft
Flow Area	0.1 ft ²
Wetted	0.88 ft
Perimeter	
Top Width	0.83 ft
Critical Depth	0.18 ft
Percent Full	8.4 %
Critical Slope	0.018959 ft/ft
Velocity	3.26 ft/s
Velocity Head	0.16 ft
Specific	0.29 ft
Energy	
Froude	1.97
Number	
Maximum	17.31 cfs
Discharge	
Discharge Full	16.09 cfs
Slope Full	0.000016 ft/ft
Flow Type	Supercritical

B.C.

7G-99

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-6D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.480 ft/ft 000
Diameter	12 in
Discharge	0.62 cfs

Results

Depth	0.15 ft
Flow Area	0.1 ft ²
Wetted	0.79 ft
Perimeter	
Top Width	0.71 ft
Critical Depth	0.33 ft
Percent Full	14.7 %
Critical Slope	0.019237 ft/ft
Velocity	8.67 ft/s
Velocity Head	1.17 ft
Specific	1.32 ft
Energy	
Froude	4.81
Number	
Maximum	14.38 cfs
Discharge	
Discharge Full	13.37 cfs
Slope Full	0.001032 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 9" m.d. riprap at outlet

B.C.

7G-100

8/01/02

Worksheet

Worksheet for Circular Channel

Culvert C-7D

Abandoned in Place

B.C.

7G-101

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-8D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	18 in
Discharge	2.36 cfs

Results

Depth	0.42 ft
Flow Area	0.4 ft ²
Wetted	1.67 ft
Perimeter	
Top Width	1.34 ft
Critical Depth	0.58 ft
Percent Full	27.8 %
Critical Slope	0.017029 ft/ft
Velocity	5.87 ft/s
Velocity Head	0.54 ft
Specific	0.95 ft
Energy	
Froude	1.89
Number	
Maximum	14.99 cfs
Discharge	
Discharge Full	13.94 cfs
Slope Full	0.001721 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 3" m.d. riprap and outlet

B.C.

7G-102

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-9D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.060 ft/ft 000
Diameter	18 in
Discharge	2.36 cfs

Results

Depth	0.42 ft
Flow Area	0.4 ft ²
Wetted	1.67 ft
Perimeter	
Top Width	1.34 ft
Critical Depth	0.58 ft
Percent Full	27.8 %
Critical Slope	0.017029 ft/ft
Velocity	5.87 ft/s
Velocity Head	0.54 ft
Specific	0.95 ft
Energy	
Froude	1.89
Number	
Maximum	14.99 cfs
Discharge	
Discharge Full	13.94 cfs
Slope Full	0.001721 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 3" m.d. riprap and outlet

B.C.

7G-103

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-10D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.030 ft/ft 000
Diameter	18 in
Discharge	0.25 cfs

Results

Depth	0.16 ft
Flow Area	0.1 ft ²
Wetted	1.01 ft
Perimeter	
Top Width	0.94 ft
Critical Depth	0.18 ft
Percent Full	11.0 %
Critical Slope	0.018805 ft/ft
Velocity	2.37 ft/s
Velocity Head	0.09 ft
Specific	0.25 ft
Energy	
Froude	1.25
Number	
Maximum	10.60 cfs
Discharge	
Discharge Full	9.85 cfs
Slope Full	0.000019 ft/ft
Flow Type	Supercritical

B.C.

7G-104

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-11D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.250 ft/ft 000
Diameter	12 in
Discharge	0.35 cfs

Results

Depth	0.13 ft
Flow Area	0.1 ft ²
Wetted	0.74 ft
Perimeter	
Top Width	0.67 ft
Critical Depth	0.24 ft
Percent Full	13.0 %
Critical Slope	0.019305 ft/ft
Velocity	5.82 ft/s
Velocity Head	0.53 ft
Specific	0.66 ft
Energy	
Froude	3.43
Number	
Maximum	10.38 cfs
Discharge	
Discharge Full	9.65 cfs
Slope Full	0.000329 ft/ft
Flow Type	Supercritical

Minimum required riprap conditions = 3" m.d. riprap at outlet

At slope = 0.05 ft/ft, Flow depth = **0.19 ft**

B.C.

7G-105

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-12D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.050 ft/ft 000
Diameter	8 in
Discharge	0.55 cfs

Results

Depth	0.28 ft
Flow Area	0.1 ft ²
Wetted	0.95 ft
Perimeter	
Top Width	0.66 ft
Critical Depth	0.35 ft
Percent Full	42.5 %
Critical Slope	0.024394 ft/ft
Velocity	3.89 ft/s
Velocity Head	0.24 ft
Specific Energy	0.52 ft
Froude Number	1.48
Maximum Discharge	1.57 cfs
Discharge Full	1.46 cfs
Slope Full	0.007061 ft/ft
Flow Type	Supercritical

B.C.

7G-106

8/01/02

Worksheet

Worksheet for Circular Channel

Project Description

Worksheet	C-13D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.024
Slope	0.070 ft/ft 000
Diameter	12 in
Discharge	0.99 cfs

Results

Depth	0.30 ft
Flow Area	0.2 ft ²
Wetted	1.16 ft
Perimeter	
Top Width	0.92 ft
Critical Depth	0.42 ft
Percent Full	29.8 %
Critical Slope	0.019770 ft/ft
Velocity	5.03 ft/s
Velocity Head	0.39 ft
Specific	0.69 ft
Energy	
Froude	1.91
Number	
Maximum	5.49 cfs
Discharge	
Discharge Full	5.11 cfs
Slope Full	0.002632 ft/ft
Flow Type	Supercritical

B.C.

7G-107

8/01/02

DITCH CHARACTERISTICS

DITCH	CHANNEL SLOPE %	CONTRIBUTING WATERSHED	PEAK Q(cfs)	BANK AND BOTTOM DESC.	MANNING'S $\eta^{(a)}$
D-1D	2 Min, 11 Max	AD-3A	0.23	Rocky Soil	0.03
D-2D	6 Min, 20 Max	AD-3A, AD-5	0.53	Rocky Soil, Bedrock	0.03
D-3D	2 Min, 6 Av 14 Max	AD-3A, AD-5, AD-7	2.36	Soil, grouted half round culvert	0.03
D-4D	2 Min, 7 Av 17 Max	AD-14	0.05	Soil	0.03
D-5D	4 Min, 10 Max	AD-9	0.23	Soil	0.03
D-6D	2 Min, 4 Max	AD-3A, AD-5, AD-7 AD-9, AD-10, AD-12 AD-14	3.63	Rocky Soil	0.03
D-7D	2 Min, 6 Av 55 Max	AD-1A, AD-1B, AD-2A AD-2B, AD-2C, AD-3B AD-4, AD-6, AD-8	4.90	Soil D_{50} . 3"	0.03 0.033
D-8D	2 Min, 7 Max	AD-13	1.23	Soil	0.03
D-8D Water Bar	3 Av.	AD-13	1.23	Soil	0.013
D-9D	4 Min, 10 Max	AD-15	1.20	Soil	0.03
D-10D	7 Min, 50 Max	AD-6, AD-3B, AD-2C	1.03	D_{50} . 4"	0.033
D-11D	41 Min Near Vertical Max	TIPPLE WASH HOSE	0.25	Grouted rip-rap	0.035
D-12D	81 Av.	TIPPLE WASH HOSE	0.25	Grouted	0.03
D-13D Water Bar	0.5 Av.	AD-6 Partial	0.23	Soil	0.03
D-14D	0.06 Av.	AU-4A	0.35	Soil	0.03
D-15D	0.05 Av.	AD-16	1.24	Soil	0.03
D-16D	0.05 Av.	AD-18	0.55	Soil	0.03
D-17D	0.08	AU-23,AD-20	0.99		

DITCH CHARACTERISTICS (cont)

DITCH	CHANNEL SLOPE %	CONTRIBUTING WATERSHED	PEAK Q (cfs)	BANK AND BOTTOM DESC.	MANNING'S η ^(a)
D-1U	2 Min, 8 Max	AU-5	2.51	D ₅₀ . 2", D _{max} . 4"	0.03
D-2U	7 Min, 10 Max	AU-6, AU-11	0.48	Rocky Soil	0.03
D-3U	4 Min, 18 Max	AU-8	0.72	Rocky Soil	0.03
D-4U	1 Min, 10 Av, 18 Max	AU-10	4.05	Rocky Soil	0.03
D-5U	4 Min, 13 Max	AU-15	0.13	Rocky Soil	0.03
D-6U	3 Min, 6 Max	AU-14	0.35	Rocky Soil	0.03
D-7U	1 Min, 16 Max	AU-12	0.34	Rocky Soil	0.03
D-8U	2 Min, 6 Av 31 Max	AU-1, AU-1A, AU-1B AU-1C, AU-2 AU-2A, AU-2B	4.75	Soil D ₅₀ . 6"	0.033
D-9U	1 Min, 6 Max	AU-16	4.92	D ₅₀ . 4"	0.03
D-10U	3 Min, 10 Max	AU-17	3.29	D ₅₀ . 4"	0.03
D-11U	3 Min, 8 Max	misc. road drainage	1.0 ^(b)	Soil	0.03
D-12U	3 Min 9 Max	AU-18	4.0	Soil D ₅₀ . 4"	0.03
D-13U	2 Min, 6 Av, 23 Max	misc. road drainage	1.0 ^(b)	Soil	0.03
D-14U	6 Min, 66 Max	Outlet of Sed Pond A	8.9	D ₅₀ . 4" D _{Max} . 10"	0.03
D-15U	5 Min, 11 Av, 16 Max	AU-3	0.52	soil	0.03
D-16U	10 Av	AU-1B	0.44	soil	0.03
D-17U	13 Av	AU-1, AU-1A	1.34	bedrock	0.03
D-18U	5 Min, 11 Av 17 Max	AU-1	0.83	soil, bedrock	0.03
D-19U	6 Av	AU-2B	0.50	soil	0.03
D-20U	16 Av	AU-42	0.67	soil	0.03
D-21U	13 Av	AU-43	1.75	D ₅₀ =3"	0.03
D-22U	11 Av	AU-19, AU-25	4.33	D ₅₀ =6"	0.03

DITCH	CHANNEL SLOPE %	CONTRIBUTING WATERSHED	PEAK Q (cfs)	BANK AND BOTTOM DESC.	MANNING'S $\eta^{(a)}$
D-23U	19 Av	AU-36	.12	soil	0.03
D-24U	14 Av	AU-35	.13	soil	0.03
D-25U	16 Av	AD-17	.16	soil	0.03
D-26U	24 Av	AU-32	.28	soil	0.03
D-27U	13 Min, 30 Max	AU-31	.32	soil	0.03
D-28U	14 Av	AU-33	.11	soil	0.03
D-29U	8 Av	AU-34	.27	soil	0.03
D-30U	13 Av	AU-25	.30	soil	0.03
D-31U	12 Av	AU-20, AU-26	2.47	bedrock	0.03
D-32U	17 Av	AU-30	.08	soil	0.03
D-33U	18 Av	AU-29	.20	soil	0.03
D-34U	11 Av	AU-24	1.66	soil	0.03
D-35U	10 Av	AU-29	0.29	soil	0.03
D-36U	8 Av	AU-27	0.03	soil	0.03
D-37U	8 Av	AU-21, AU-26	1.25	soil	0.03
D-38U	12 Min, 20 Max	AU-21	1.15	$D_{50} = 3''$	0.03
D-39U	10 Av	AU-28	0.09	soil	0.03
D-40U	9 Av	AU-28A, AU-39U	2.41	$D_{50} = 3''$	0.03
D-41U	15 Av	AU-22, AU-23A, AU-40U	2.27	$D_{50} = 4''$	0.03
D-42U	36 Av, 63 Max	AU-23A	0.04	soil	0.03
D-43U	20 Min, 45 Max	AU-23	0.64	$D_{50} = 5''$	0.03

(a) Based on tables from Barfield et al (1981) and the equation $\eta = .0395(D_{50})^{1/6}$; (D in ft)

(b) Peak Q for misc. road drainage assumed to be 1.0 cfs based on similar disturbed areas.

(c) See table 7.2-10 for summary of diversion ditch calculation

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet DITCH D-1D
 Flow Element Trapezoidal
 Channel
 Method Manning's
 Formula
 Solve For Channel
 Slope

Input Data

Mannings	0.03
Coefficient	0
Depth	0.36 ft
Left Side Slope	1.00 V : H
Right Side	1.00 V : Slope H
Bottom Width	0.00 ft
Discharge	0.23 cfs

Results

Slope	0.02005 ft/ft 2
Flow Area	0.1 ft ²
Wetted	1.02 ft
Perimeter	
Top Width	0.72 ft
Critical Depth	0.32 ft
Critical Slope	0.03839 ft/ft 9
Velocity	1.77 ft/s
Velocity	0.05 ft
Head	
Specific	0.41 ft
Energy	
Froude	0.74
Number	
Flow Type	Subcritical

Use Minimum Depth = 0.67 ft
 Velocity < 5 fps

Minimum Freeboard = 0.30 ft
 No rip-rap required

B.C.

7G-111

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-1D (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Slope

Input Data

Mannings	0.03
Coefficient	0
Depth	0.26 ft
Left Side Slope	1.00 V : H
Right Side	1.00 V : H
Slope	H
Bottom Width	0.00 ft
Discharge	0.23 cfs

Results

Slope	0.113739 ft/ft
Flow Area	0.1 ft ²
Wetted	0.74 ft
Perimeter	
Top Width	0.52 ft
Critical Depth	0.32 ft
Critical Slope	0.038399 ft/ft
Velocity	3.40 ft/s
Velocity	0.18 ft
Head	
Specific	0.44 ft
Energy	
Froude	1.66
Number	
Flow Type	Supercritical

B.C.

7G-112

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-2D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.060 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.53 cfs

Results

Depth	0.40 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.13 ft
Top Width	0.80 ft
Critical Depth	0.45 ft
Critical Slope	0.034354 ft/ft
Velocity	3.30 ft/s
Velocity	0.17 ft
Head	
Specific Energy	0.57 ft
Froude	1.30
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.67 ft
Velocity < 5 fps

Minimum Freeboard = 0.27 ft
No rip-rap required

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-2D (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.200 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.53 cfs

Results

Depth	0.32 ft
Flow Area	0.1 ft ²
Wetted	0.90 ft
Perimeter	
Top Width	0.64 ft
Critical Depth	0.45 ft
Critical Slope	0.034354 ft/ft
Velocity	5.18 ft/s
Velocity	0.42 ft
Head	
Specific Energy	0.74 ft
Froude	2.28
Number	
Flow Type	Supercritical

B.C.

7G-114

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet DITCH D-3D
 Flow Element Trapezoidal
 Channel
 Method Manning's
 Formula
 Solve For Channel
 Depth

Input Data

Mannings Coefficient 0.030
 Slope 0.020 ft/ft
 000
 Left Side Slope 1.00 V : H
 Right Side Slope 1.00 V : H
 Bottom Width 0.00 ft
 Discharge 2.36 cfs

Results

Depth 0.86 ft
 Flow Area 0.7 ft²
 Wetted 2.44 ft
 Perimeter
 Top Width 1.72 ft
 Critical Depth 0.81 ft
 Critical Slope 0.02815 ft/ft
 1
 Velocity 3.17 ft/s
 Velocity 0.16 ft
 Head
 Specific 1.02 ft
 Energy
 Froude 0.85
 Number
 Flow Type Subcritical

Use Minimum Depth = 1 ft
 Velocity < 5 fps
 At Steep Slope 18%

Minimum Freeboard = 0.14 ft
 No rip-rap required
 Grouted half ground culvert

B.C.

7G-115

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-3D (Avg Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.060 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	2.36 cfs

Results

Depth	0.70 ft
Flow Area	0.5 ft ²
Wetted Perimeter	1.99 ft
Top Width	1.40 ft
Critical Depth	0.81 ft
Critical Slope	0.028151 ft/ft
Velocity	4.79 ft/s
Velocity	0.36 ft
Head	
Specific Energy	1.06 ft
Froude Number	1.43
Flow Type	Supercritical

B.C.

7G-116

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-3D (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.180 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	2.36 cfs

Results

Depth	0.57 ft
Flow Area	0.3 ft ²
Wetted Perimeter	1.62 ft
Top Width	1.14 ft
Critical Depth	0.81 ft
Critical Slope	0.028151 ft/ft
Velocity	7.23 ft/s
Velocity	0.81 ft
Head	
Specific Energy	1.38 ft
Froude Number	2.39
Flow Type	Supercritical

B.C.

7G-117

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet DITCH D-4D
 Flow Element Trapezoidal
 Channel
 Method Manning's
 Formula
 Solve For Channel
 Depth

Input Data

Mannings Coefficient 0.030
 Slope 0.020 ft/ft
 000
 Left Side Slope 1.00 V : H
 Right Side Slope 1.00 V : H
 Bottom Width 0.00 ft
 Discharge 0.05 cfs

Results

Depth 0.20 ft
 Flow Area 4.1e-2 ft²
 Wetted 0.57 ft
 Perimeter
 Top Width 0.41 ft
 Critical Depth 0.17 ft
 Critical Slope 0.04706 ft/ft
 4
 Velocity 1.21 ft/s
 Velocity 0.02 ft
 Head
 Specific 0.23 ft
 Energy
 Froude 0.67
 Number
 Flow Type Subcritical

Use Minimum Depth = 1 ft
 Velocity < 5 fps

Minimum Freeboard = 0.80 ft
 No rip-rap required

B.C.

7G-118

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-4D (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.170 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.05 cfs

Results

Depth	0.14 ft
Flow Area	1.9e-2 ft ²
Wetted Perimeter	0.38 ft
Top Width	0.27 ft
Critical Depth	0.17 ft
Critical Slope	0.047062 ft/ft
Velocity	2.70 ft/s
Velocity	0.11 ft
Head	
Specific Energy	0.25 ft
Froude	1.83
Number	
Flow Type	Supercritical

B.C.

7G-119

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-5D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.040 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.23 cfs

Results

Depth	0.32 ft
Flow Area	0.1 ft ²
Wetted Perimeter	0.89 ft
Top Width	0.63 ft
Critical Depth	0.32 ft
Critical Slope	0.038399 ft/ft
Velocity	2.30 ft/s
Velocity	0.08 ft
Head	
Specific Energy	0.40 ft
Froude	1.02
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.67 ft
Velocity < 5 fps

Minimum Freeboard = 0.34 ft
No rip-rap required

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-5D (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.100 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.23 cfs

Results

Depth	0.27 ft
Flow Area	0.1 ft ²
Wetted Perimeter	0.75 ft
Top Width	0.53 ft
Critical Depth	0.32 ft
Critical Slope	0.038400 ft/ft
Velocity	3.24 ft/s
Velocity	0.16 ft
Head	
Specific Energy	0.43 ft
Froude	1.57
Number	
Flow Type	Supercritical

B.C.

7G-121

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-6D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.040 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	3.63 cfs

Results

Depth	0.89 ft
Flow Area	0.8 ft ²
Wetted Perimeter	2.52 ft
Top Width	1.78 ft
Critical Depth	0.96 ft
Critical Slope	0.026581 ft/ft
Velocity	4.58 ft/s
Velocity	0.33 ft
Head	
Specific Energy	1.22 ft
Froude	1.21
Number	
Flow Type	Supercritical

Use Minimum Depth = 1.5 ft
Velocity < 5 fps

Minimum Freeboard = 0.45 ft
No rip-rap required

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-6D (Min Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.020 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	3.63 cfs

Results

Depth	1.01 ft
Flow Area	1.0 ft ²
Wetted Perimeter	2.87 ft
Top Width	2.03 ft
Critical Depth	0.96 ft
Critical Slope	0.02658 ft/ft 1
Velocity	3.53 ft/s
Velocity	0.19 ft
Head	
Specific Energy	1.21 ft
Froude Number	0.88
Flow Type	Subcritic al

B.C.

7G-123

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-7D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.020 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	2.00 ft
Discharge	4.49 cfs

Results

Depth	0.48 ft
Flow Area	1.3 ft ²
Wetted	3.71 ft
Perimeter	
Top Width	3.42 ft
Critical Depth	0.48 ft
Critical Slope	0.02023 ft/ft 0
Velocity	3.47 ft/s
Velocity	0.19 ft
Head	
Specific Energy	0.66 ft
Froude	0.99
Number	
Flow Type	Subcritic al

Use Minimum Depth = 0.75 ft
 Velocity < 5 fps
 At steep slope 55%

Minimum Freeboard = 0.27 ft
 No rip-rap required
 Use D₅₀ = 6"

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-7D (Avg Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.060 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	2.00 ft
Discharge	4.49 cfs

Results

Depth	0.35 ft
Flow Area	0.9 ft ²
Wetted Perimeter	3.26 ft
Top Width	3.05 ft
Critical Depth	0.48 ft
Critical Slope	0.020230 ft/ft
Velocity	5.08 ft/s
Velocity	0.40 ft
Head	
Specific Energy	0.75 ft
Froude	1.66
Number	
Flow Type	Supercritical

B.C.

7G-125

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-7D (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.550 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	2.00 ft
Discharge	4.49 cfs

Results

Depth	0.18 ft
Flow Area	0.4 ft ²
Wetted Perimeter	2.66 ft
Top Width	2.55 ft
Critical Depth	0.48 ft
Critical Slope	0.020230 ft/ft
Velocity	10.71 ft/s
Velocity	1.78 ft
Head	
Specific Energy	1.97 ft
Froude	4.66
Number	
Flow Type	Supercritical

B.C.

7G-126

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-8D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.020 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	1.23 cfs

Results

Depth	0.68 ft
Flow Area	0.5 ft ²
Wetted Perimeter	1.91 ft
Top Width	1.35 ft
Critical Depth	0.62 ft
Critical Slope	0.03070 ft/ft 7
Velocity	2.70 ft/s
Velocity	0.11 ft
Head	
Specific Energy	0.79 ft
Froude	0.82
Number	
Flow Type	Subcritic al

Use Minimum Depth = 1 ft
Velocity < 5 fps

Minimum Freeboard = 0.32 ft
No rip-rap required

B.C.

7G-127

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-8D (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.070 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	1.23 cfs

Results

Depth	0.53 ft
Flow Area	0.3 ft ²
Wetted Perimeter	1.51 ft
Top Width	1.07 ft
Critical Depth	0.62 ft
Critical Slope	0.030707 ft/ft
Velocity	4.31 ft/s
Velocity	0.29 ft
Head	
Specific Energy	0.82 ft
Froude	1.47
Number	
Flow Type	Supercritical

B.C.

7G-128

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-8D
	Water Bar
Flow Element	Trapezoidal
	Channel
Method	Manning's
	Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.013
Slope	0.030 ft/ft 000
Left Side Slope	0.50 V : H
Right Side Slope	0.50 V : H
Bottom Width	0.00 ft
Discharge	1.23 cfs

Results

Depth	0.33 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.49 ft
Top Width	1.33 ft
Critical Depth	0.47 ft
Critical Slope	0.004623 ft/ft
Velocity	5.56 ft/s
Velocity	0.48 ft
Head	
Specific Energy	0.81 ft
Froude Number	2.40
Flow Type	Supercritical

Use Minimum Depth = 67 ft
Velocity < 5 fps

Minimum Freeboard = 0.34 ft
No rip-rap required

B.C.

7G-129

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-9D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.040 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	1.20 cfs

Results

Depth	0.59 ft
Flow Area	0.3 ft ²
Wetted Perimeter	1.66 ft
Top Width	1.18 ft
Critical Depth	0.62 ft
Critical Slope	0.030808 ft/ft
Velocity	3.47 ft/s
Velocity	0.19 ft
Head	
Specific Energy	0.78 ft
Froude	1.13
Number	
Flow Type	Supercritical

Use Minimum Depth = 1 ft Velocity < 5 fps	Minimum Freeboard = 0.41 ft No rip-rap required
--	--

B.C.

7G-130

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-9D (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.100 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	1.20 cfs

Results

Depth	0.49 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.40 ft
Top Width	0.99 ft
Critical Depth	0.62 ft
Critical Slope	0.030808 ft/ft
Velocity	4.90 ft/s
Velocity	0.37 ft
Head	
Specific Energy	0.87 ft
Froude	1.74
Number	
Flow Type	Supercritical

B.C.

7G-131

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-10D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.033
Slope	0.070 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	1.00 ft
Discharge	1.03 cfs

Results

Depth	0.22 ft
Flow Area	0.3 ft ²
Wetted	1.79 ft
Perimeter	
Top Width	1.65 ft
Critical Depth	0.28 ft
Critical Slope	0.029819 ft/ft
Velocity	3.55 ft/s
Velocity	0.20 ft
Head	
Specific Energy	0.41 ft
Froude	1.49
Number	
Flow Type	Supercritical

Use Minimum Depth = 8 ft
Velocity < 6 fps

Minimum Freeboard = 0.45 ft
Use D₅₀ = 4"

B.C.

7G-132

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-10D (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.033
Slope	0.500 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	1.00 ft
Discharge	1.03 cfs

Results

Depth	0.12 ft
Flow Area	0.1 ft ²
Wetted Perimeter	1.45 ft
Top Width	1.37 ft
Critical Depth	0.28 ft
Critical Slope	0.029819 ft/ft
Velocity	6.96 ft/s
Velocity	0.75 ft
Head	
Specific Energy	0.88 ft
Froude	3.74
Number	
Flow Type	Supercritical

B.C.

7G-133

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-11D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.035
Slope	0.410 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.25 cfs

Results

Depth	0.22 ft
Flow Area	5.0e-2 ft ²
Wetted Perimeter	0.63 ft
Top Width	0.45 ft
Critical Depth	0.33 ft
Critical Slope	0.051688 ft/ft
Velocity	5.01 ft/s
Velocity	0.39 ft
Head	
Specific Energy	0.61 ft
Froude	2.64
Number	
Flow Type	Supercritical

Use Minimum Depth = 6 inches Velocity < 5 fps At near vertical slope	Minimum Freeboard = 0.28 ft No riprap required typically Use grouted riprap
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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-11D (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.035
Slope	9.999 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.25 cfs

Results

Depth	0.12 ft
Flow Area	1.5e-2 ft ²
Wetted Perimeter	0.35 ft
Top Width	0.25 ft
Critical Depth	0.33 ft
Critical Slope	0.051688 ft/ft
Velocity	16.58 ft/s
Velocity	4.27 ft
Head	
Specific Energy	4.40 ft
Froude	11.80
Number	
Flow Type	Supercritical

B.C.

7G-135

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	DITCH D-12D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.033
Slope	0.810 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	1.00 ft
Discharge	0.25 cfs

Results

Depth	0.05 ft
Flow Area	5.0e-2 ft ²
Wetted Perimeter	1.13 ft
Top Width	1.09 ft
Critical Depth	0.12 ft
Critical Slope	0.036907 ft/ft
Velocity	5.03 ft/s
Velocity	0.39 ft
Head	
Specific Energy	0.44 ft
Froude	4.17
Number	
Flow Type	Supercritical

Use Minimum Depth = 6 inches
Velocity < 5 fps

Minimum Freeboard = 0.45 ft
No riprap required

B.C.

7G-136

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-13D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.005 ft/ft 000
Left Side Slope	0.10 V : H
Right Side Slope	0.50 V : H
Bottom Width	0.00 ft
Discharge	0.23 cfs

Results

Depth	0.22 ft
Flow Area	0.3 ft ²
Wetted Perimeter	2.70 ft
Top Width	2.64 ft
Critical Depth	0.16 ft
Critical Slope	0.03169 ft/ft 8
Velocity	0.79 ft/s
Velocity	0.01 ft
Head	
Specific Energy	0.23 ft
Froude	0.42
Number	
Flow Type	Subcritic al

Use Minimum Depth = 0.5 ft
Velocity < 5 fps

Minimum Freeboard = 0.34 ft
No riprap required

B.C.

7G-137

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-14D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.060 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	0.35 cfs

Results

Depth	0.28 ft
Flow Area	0.1 ft ²
Wetted Perimeter	1.02 ft
Top Width	0.85 ft
Critical Depth	0.32 ft
Critical Slope	0.030894 ft/ft
Velocity	2.92 ft/s
Velocity	0.13 ft
Head	
Specific Energy	0.42 ft
Froude	1.36
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.67 ft
 Velocity < 5 fps

Minimum Freeboard = 0.39 ft
 No riprap required

B.C.

7G-138

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-15D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.050 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	1.24 cfs

Results

Depth	0.57 ft
Flow Area	0.3 ft ²
Wetted Perimeter	1.61 ft
Top Width	1.14 ft
Critical Depth	0.63 ft
Critical Slope	0.030674 ft/ft
Velocity	3.81 ft/s
Velocity	0.23 ft
Head	
Specific Energy	0.80 ft
Froude	1.26
Number	
Flow Type	Supercritical

Notes: Use Min. Depth = 1.0 ft: Minimum Freeboard = 0.43 ft.

Velocity < 5 fps: No riprap required

B.C.

7G-139

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-16D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.050 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.55 cfs

Results

Depth	0.42 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.19 ft
Top Width	0.84 ft
Critical Depth	0.45 ft
Critical Slope	0.034185 ft/ft
Velocity	3.11 ft/s
Velocity	0.15 ft
Head	
Specific Energy	0.57 ft
Froude	1.20
Number	
Flow Type	Supercritical

Notes: Use Min. Depth = 0.75 ft: Minimum Freeboard = 0.33 ft.

Velocity < 5 fps: No riprap required

B.C.

7G-140

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-17D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.080 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.99 cfs

Results

Depth	0.48 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.36 ft
Top Width	0.96 ft
Critical Depth	0.57 ft
Critical Slope	0.031608 ft/ft
Velocity	4.29 ft/s
Velocity	0.29 ft
Head	
Specific Energy	0.77 ft
Froude	1.55
Number	
Flow Type	Supercritical

Use Minimum Depth = 1.0 ft
Velocity < 5 fps

Minimum Freeboard = 0.52 ft
No riprap required

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-1U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.020 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	2.00 ft
Discharge	2.51 cfs

Results

Depth	0.36 ft
Flow Area	0.8 ft ²
Wetted Perimeter	3.01 ft
Top Width	2.71 ft
Critical Depth	0.34 ft
Critical Slope	0.02240 ft/ft 3
Velocity	2.99 ft/s
Velocity	0.14 ft
Head	
Specific Energy	0.50 ft
Froude Number	0.95
Flow Type	Subcritic al

Use Minimum Depth = .67 ft Velocity < 5 fps	Minimum Freeboard = 0.31 ft No riprap required
--	---

B.C.

7G-142

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-1U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.080 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	2.00 ft
Discharge	2.51 cfs

Results

Depth	0.24 ft
Flow Area	0.5 ft ²
Wetted Perimeter	2.67 ft
Top Width	2.47 ft
Critical Depth	0.34 ft
Critical Slope	0.022403 ft/ft
Velocity	4.76 ft/s
Velocity	0.35 ft
Head	
Specific Energy	0.59 ft
Froude Number	1.81
Flow Type	Supercritical

B.C.

7G-143

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-2U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.070 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.48 cfs

Results

Depth	0.38 ft
Flow Area	0.1 ft ²
Wetted Perimeter	1.06 ft
Top Width	0.75 ft
Critical Depth	0.43 ft
Critical Slope	0.034812 ft/ft
Velocity	3.41 ft/s
Velocity	0.18 ft
Head	
Specific Energy	0.56 ft
Froude	1.39
Number	
Flow Type	Supercritical

Use Minimum Depth = .67 ft
 Velocity < 5 fps

Minimum Freeboard = 0.29 ft
 No riprap required

B.C.

7G-144

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-2U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.100 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.48 cfs

Results

Depth	0.35 ft
Flow Area	0.1 ft ²
Wetted Perimeter	0.99 ft
Top Width	0.70 ft
Critical Depth	0.43 ft
Critical Slope	0.034810 ft/ft
Velocity	3.90 ft/s
Velocity	0.24 ft
Head	
Specific Energy	0.59 ft
Froude Number	1.64
Flow Type	Supercritical

B.C.

7G-145

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-3U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.040 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	1.00 ft
Discharge	0.72 cfs

Results

Depth	0.21 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.58 ft
Top Width	1.41 ft
Critical Depth	0.23 ft
Critical Slope	0.026633 ft/ft
Velocity	2.89 ft/s
Velocity	0.13 ft
Head	
Specific Energy	0.34 ft
Froude	1.21
Number	
Flow Type	Supercritical

Use Minimum Depth = .05 ft
Velocity < 5 fps

Minimum Freeboard = 0.29 ft
No riprap required

B.C.

7G-146

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-3U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.180 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	1.00 ft
Discharge	0.72 cfs

Results

Depth	0.13 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.37 ft
Top Width	1.26 ft
Critical Depth	0.23 ft
Critical Slope	0.026633 ft/ft
Velocity	4.80 ft/s
Velocity	0.36 ft
Head	
Specific Energy	0.49 ft
Froude Number	2.46
Flow Type	Supercritical

B.C.

7G-147

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-4U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.100 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	1.00 ft
Discharge	4.05 cfs

Results

Depth	0.40 ft
Flow Area	0.6 ft ²
Wetted Perimeter	2.43 ft
Top Width	2.19 ft
Critical Depth	0.59 ft
Critical Slope	0.020879 ft/ft
Velocity	6.39 ft/s
Velocity	0.64 ft
Head	
Specific Energy	1.03 ft
Froude	2.09
Number	
Flow Type	Supercritical

B.C.

7G-148

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-4U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.180 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	1.00 ft
Discharge	4.05 cfs

Results

Depth	0.34 ft
Flow Area	0.5 ft ²
Wetted Perimeter	2.22 ft
Top Width	2.01 ft
Critical Depth	0.59 ft
Critical Slope	0.020879 ft/ft
Velocity	7.90 ft/s
Velocity	0.97 ft
Head	
Specific Energy	1.31 ft
Froude Number	2.76
Flow Type	Supercritical

B.C.

7G-149

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet D-5U
 Flow Element Trapezoidal
 Channel
 Method Manning's
 Formula
 Solve For Channel
 Depth

Input Data

Mannings Coefficient	0.030
Slope	0.040 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.13 cfs

Results

Depth	0.26 ft
Flow Area	0.1 ft ²
Wetted Perimeter	0.72 ft
Top Width	0.51 ft
Critical Depth	0.25 ft
Critical Slope	0.04143 ft/ft 5
Velocity	1.99 ft/s
Velocity	0.06 ft
Head	
Specific Energy	0.32 ft
Froude Number	0.98
Flow Type	Subcritical

Use Minimum Depth = .05 ft
 Velocity < 5 fps

Minimum Freeboard = 0.24 ft
 No riprap required

B.C.

7G-150

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-5U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.130 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.13 cfs

Results

Depth	0.20 ft
Flow Area	4.2e-2 ft ²
Wetted Perimeter	0.58 ft
Top Width	0.41 ft
Critical Depth	0.25 ft
Critical Slope	0.041434 ft/ft
Velocity	3.10 ft/s
Velocity	0.15 ft
Head	
Specific Energy	0.35 ft
Froude Number	1.71
Flow Type	Supercritical

B.C.

7G-151

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-6U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.030 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.35 cfs

Results

Depth	0.39 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.11 ft
Top Width	0.78 ft
Critical Depth	0.38 ft
Critical Slope	0.03630 ft/ft 9
Velocity	2.29 ft/s
Velocity	0.08 ft
Head	
Specific Energy	0.47 ft
Froude Number	0.91
Flow Type	Subcritic al

B.C.

7G-152

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-6U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.060 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.35 cfs

Results

Depth	0.34 ft
Flow Area	0.1 ft ²
Wetted Perimeter	0.97 ft
Top Width	0.69 ft
Critical Depth	0.38 ft
Critical Slope	0.036309 ft/ft
Velocity	2.97 ft/s
Velocity	0.14 ft
Head	
Specific Energy	0.48 ft
Froude Number	1.27
Flow Type	Supercritical

Use Minimum Depth = 8 in.
Velocity < 5 fps

Minimum Freeboard = 0.28 ft
No rip-rap required

B.C.

7G-153

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-7U (min slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.010 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.34 cfs

Results

Depth	0.47 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.34 ft
Top Width	0.95 ft
Critical Depth	0.37 ft
Critical Slope	0.03644 ft/ft 9
Velocity	1.51 ft/s
Velocity Head	0.04 ft
Specific Energy	0.51 ft
Froude Number	0.55
Flow Type	Subcritical

Use Minimum Depth = 8 in
Velocity < 5 fps

Minimum Freeboard = 0.20 ft
No riprap required

B.C.

7G-154

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-7U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.190 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.34 cfs

Results

Depth	0.27 ft
Flow Area	0.1 ft ²
Wetted Perimeter	0.77 ft
Top Width	0.55 ft
Critical Depth	0.37 ft
Critical Slope	0.036450 ft/ft
Velocity	4.55 ft/s
Velocity	0.32 ft
Head	
Specific Energy	0.59 ft
Froude Number	2.17
Flow Type	Supercritical

B.C.

7G-155

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-8U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.033
Slope	0.020 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	2.00 ft
Discharge	0.75 cfs

Results

Depth	0.18 ft
Flow Area	0.4 ft ²
Wetted Perimeter	2.65 ft
Top Width	2.54 ft
Critical Depth	0.16 ft
Critical Slope	0.03198 ft/ft 8
Velocity	1.83 ft/s
Velocity	0.05 ft
Head	
Specific Energy	0.23 ft
Froude	0.81
Number	
Flow Type	Subcritic al

Use Minimum Depth = 0.67 ft
 Velocity < 5 fps
 At steep slope 31%

Minimum Freeboard = 0.15 ft
 No riprap required typically
 Use D₅₀ = 6"

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-8U (Avg Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.033
Slope	0.060 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	2.00 ft
Discharge	0.75 cfs

Results

Depth	0.13 ft
Flow Area	0.3 ft ²
Wetted Perimeter	2.47 ft
Top Width	2.39 ft
Critical Depth	0.16 ft
Critical Slope	0.031988 ft/ft
Velocity	2.62 ft/s
Velocity	0.11 ft
Head	
Specific Energy	0.24 ft
Froude Number	1.34
Flow Type	Supercritical

B.C.

7G-157

8/01/02

Project Engineer: Charles Reynolds
 FlowMaster v6.0 [614b]
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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-8U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.033
Slope	0.310 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	2.00 ft
Discharge	0.75 cfs

Results

Depth	0.08 ft
Flow Area	0.2 ft ²
Wetted Perimeter	2.29 ft
Top Width	2.24 ft
Critical Depth	0.16 ft
Critical Slope	0.031988 ft/ft
Velocity	4.42 ft/s
Velocity	0.30 ft
Head	
Specific Energy	0.38 ft
Froude Number	2.83
Flow Type	Supercritical

B.C.

7G-158

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-9U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.010 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	3.00 ft
Discharge	4.92 cfs

Results

Depth	0.52 ft
Flow Area	1.8 ft ²
Wetted Perimeter	4.46 ft
Top Width	4.03 ft
Critical Depth	0.42 ft
Critical Slope	0.02046 ft/ft 9
Velocity	2.72 ft/s
Velocity	0.11 ft
Head	
Specific Energy	0.63 ft
Froude Number	0.71
Flow Type	Subcritic al

Use Minimum Depth = 1 ft Velocity < 5 fps	Minimum Freeboard = 0.48 ft No riprap required
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B.C.

7G-159

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-9U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.060 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	3.00 ft
Discharge	4.92 cfs

Results

Depth	0.30 ft
Flow Area	1.0 ft ²
Wetted Perimeter	3.85 ft
Top Width	3.60 ft
Critical Depth	0.42 ft
Critical Slope	0.020469 ft/ft
Velocity	4.93 ft/s
Velocity	0.38 ft
Head	
Specific Energy	0.68 ft
Froude Number	1.65
Flow Type	Supercritical

B.C.

7G-160

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-10U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.030 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	3.00 ft
Discharge	3.29 cfs

Results

Depth	0.29 ft
Flow Area	1.0 ft ²
Wetted Perimeter	3.83 ft
Top Width	3.58 ft
Critical Depth	0.32 ft
Critical Slope	0.021680 ft/ft
Velocity	3.42 ft/s
Velocity	0.18 ft
Head	
Specific Energy	0.47 ft
Froude	1.16
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.5 ft
Velocity < 5 fps

Minimum Freeboard = 0.31 ft
No riprap required

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-10U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.100 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	3.00 ft
Discharge	3.29 cfs

Results

Depth	0.20 ft
Flow Area	0.7 ft ²
Wetted Perimeter	3.58 ft
Top Width	3.41 ft
Critical Depth	0.32 ft
Critical Slope	0.021680 ft/ft
Velocity	5.04 ft/s
Velocity	0.39 ft
Head	
Specific Energy	0.60 ft
Froude Number	2.03
Flow Type	Supercritical

B.C.

7G-162

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-11U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.030 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	1.00 cfs

Results

Depth	0.58 ft
Flow Area	0.3 ft ²
Wetted Perimeter	1.64 ft
Top Width	1.16 ft
Critical Depth	0.57 ft
Critical Slope	0.03156 ft/ft 5
Velocity	2.98 ft/s
Velocity	0.14 ft
Head	
Specific Energy	0.72 ft
Froude Number	0.98
Flow Type	Subcritic al

Use Minimum Depth = 1 ft
Velocity < 5 fps

Minimum Freeboard = 0.42 ft
No riprap required

B.C.

7G-163

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-11U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.080 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	1.00 cfs

Results

Depth	0.48 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.36 ft
Top Width	0.96 ft
Critical Depth	0.57 ft
Critical Slope	0.031566 ft/ft
Velocity	4.31 ft/s
Velocity	0.29 ft
Head	
Specific Energy	0.77 ft
Froude Number	1.55
Flow Type	Supercritical

B.C.

7G-164

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-12U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.030 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	4.00 cfs

Results

Depth	0.80 ft
Flow Area	1.0 ft ²
Wetted Perimeter	2.90 ft
Top Width	2.41 ft
Critical Depth	0.85 ft
Critical Slope	0.022298 ft/ft
Velocity	4.13 ft/s
Velocity	0.27 ft
Head	
Specific Energy	1.07 ft
Froude	1.15
Number	
Flow Type	Supercritical

Use Minimum Depth = 1 ft
 Velocity < 5 fps
 At steep slope 9%

Minimum Freeboard = 0.20 ft
 No riprap required
 Use D₅₀ = 4

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-12U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.090 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	4.00 cfs

Results

Depth	0.65 ft
Flow Area	0.6 ft ²
Wetted Perimeter	2.36 ft
Top Width	1.96 ft
Critical Depth	0.85 ft
Critical Slope	0.022298 ft/ft
Velocity	6.24 ft/s
Velocity	0.60 ft
Head	
Specific Energy	1.26 ft
Froude Number	1.92
Flow Type	Supercritical

B.C.

7G-166

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-13U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.020 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	1.00 cfs

Results

Depth	0.62 ft
Flow Area	0.4 ft ²
Wetted Perimeter	1.77 ft
Top Width	1.25 ft
Critical Depth	0.57 ft
Critical Slope	0.03156 ft/ft 6
Velocity	2.56 ft/s
Velocity	0.10 ft
Head	
Specific Energy	0.73 ft
Froude Number	0.81
Flow Type	Subcritic al

Use Minimum Depth = 1 ft
Velocity < 5 fps

Minimum Freeboard = 0.38 ft
No riprap required

B.C.

7G-167

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-13U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.090 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	1.00 cfs

Results

Depth	0.47 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.33 ft
Top Width	0.94 ft
Critical Depth	0.57 ft
Critical Slope	0.031567 ft/ft
Velocity	4.50 ft/s
Velocity	0.31 ft
Head	
Specific Energy	0.79 ft
Froude Number	1.63
Flow Type	Supercritical

B.C.

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8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-14U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.033
Slope	0.060 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	4.00 ft
Discharge	8.90 cfs

Results

Depth	0.38 ft
Flow Area	1.7 ft ²
Wetted Perimeter	5.36 ft
Top Width	5.13 ft
Critical Depth	0.50 ft
Critical Slope	0.022531 ft/ft
Velocity	5.17 ft/s
Velocity	0.42 ft
Head	
Specific Energy	0.79 ft
Froude	1.57
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.5 ft
 Velocity < 5 fps
 At maximum slope 66%

Minimum Freeboard = 0.13 ft
 Use D₅₀ = 4"
 Use D₅₀ = 10"

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-14U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.033
Slope	0.660 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	4.00 ft
Discharge	8.90 cfs

Results

Depth	0.19 ft
Flow Area	0.8 ft ²
Wetted Perimeter	4.67 ft
Top Width	4.56 ft
Critical Depth	0.50 ft
Critical Slope	0.022531 ft/ft
Velocity	11.22 ft/s
Velocity	1.96 ft
Head	
Specific Energy	2.14 ft
Froude Number	4.74
Flow Type	Supercritical

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-15U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.050 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	0.52 cfs

Results

Depth	0.34 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.22 ft
Top Width	1.02 ft
Critical Depth	0.38 ft
Critical Slope	0.029269 ft/ft
Velocity	3.00 ft/s
Velocity	0.14 ft
Head	
Specific Energy	0.48 ft
Froude	1.29
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.67 ft
Velocity < 5 fps

Minimum Freeboard = 0.33 ft
No riprap required

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-15 U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.160 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	0.52 cfs

Results

Depth	0.27 ft
Flow Area	0.1 ft ²
Wetted Perimeter	0.98 ft
Top Width	0.82 ft
Critical Depth	0.38 ft
Critical Slope	0.029269 ft/ft
Velocity	4.65 ft/s
Velocity	0.34 ft
Head	
Specific Energy	0.61 ft
Froude Number	2.22
Flow Type	Supercritical

B.C.

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8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-16U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.100 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	0.44 cfs

Results

Depth	0.28 ft
Flow Area	0.1 ft ²
Wetted Perimeter	1.01 ft
Top Width	0.84 ft
Critical Depth	0.35 ft
Critical Slope	0.029927 ft/ft
Velocity	3.74 ft/s
Velocity	0.22 ft
Head	
Specific Energy	0.50 ft
Froude	1.76
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.67 ft
Velocity < 5 fps

Minimum Freeboard = 0.39 ft
No riprap required

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-17U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.130 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	1.34 cfs

Results

Depth	0.40 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.46 ft
Top Width	1.21 ft
Critical Depth	0.55 ft
Critical Slope	0.025795 ft/ft
Velocity	5.45 ft/s
Velocity	0.46 ft
Head	
Specific Energy	0.87 ft
Froude	2.13
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.67 ft
Velocity < 5 fps

Minimum Freeboard = 0.27 ft
Use D₅₀ = 3"

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-18U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.050 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	0.83 cfs

Results

Depth	0.40 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.46 ft
Top Width	1.21 ft
Critical Depth	0.45 ft
Critical Slope	0.027496 ft/ft
Velocity	3.38 ft/s
Velocity	0.18 ft
Head	
Specific Energy	0.58 ft
Froude	1.32
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.67 ft
 Velocity < 5 fps
 At maximum slope 17%

Minimum Freeboard = 0.27 ft
 No riprap required typically
 Use D₅₀ = 3"

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-18U (Avg Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.110 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	0.83 cfs

Results

Depth	0.35 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.26 ft
Top Width	1.05 ft
Critical Depth	0.45 ft
Critical Slope	0.027496 ft/ft
Velocity	4.54 ft/s
Velocity	0.32 ft
Head	
Specific Energy	0.67 ft
Froude Number	1.92
Flow Type	Supercritical

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-18U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.170 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	0.83 cfs

Results

Depth	0.32 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.16 ft
Top Width	0.97 ft
Critical Depth	0.45 ft
Critical Slope	0.027496 ft/ft
Velocity	5.34 ft/s
Velocity	0.44 ft
Head	
Specific Energy	0.77 ft
Froude Number	2.35
Flow Type	Supercritical

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-19U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.060 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	0.50 cfs

Results

Depth	0.32 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.17 ft
Top Width	0.97 ft
Critical Depth	0.37 ft
Critical Slope	0.029420 ft/ft
Velocity	3.19 ft/s
Velocity	0.16 ft
Head	
Specific Energy	0.48 ft
Froude	1.40
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.67 ft
Velocity < 5 fps

Minimum Freeboard = 0.34 ft
No riprap required

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-20U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.160 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.67 cfs

Results

Depth	0.36 ft
Flow Area	0.1 ft ²
Wetted Perimeter	1.03 ft
Top Width	0.73 ft
Critical Depth	0.49 ft
Critical Slope	0.033297 ft/ft
Velocity	5.05 ft/s
Velocity	0.40 ft
Head	
Specific Energy	0.76 ft
Froude	2.09
Number	
Flow Type	Supercritical

Notes: Use Min. Depth = 0.67 ft: Minimum Freeboard = 0.33 ft.

Velocity < 5 fps: No riprap required

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-21U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.130 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	1.75 cfs

Results

Depth	0.54 ft
Flow Area	0.3 ft ²
Wetted Perimeter	1.54 ft
Top Width	1.09 ft
Critical Depth	0.72 ft
Critical Slope	0.029296 ft/ft
Velocity	5.94 ft/s
Velocity	0.55 ft
Head	
Specific Energy	1.09 ft
Froude	2.01
Number	
Flow Type	Supercritical

Notes: Use Min. Depth = 1.0 ft: Minimum Freeboard = 046 ft.

Velocity > 5 fps: Use D50 = 3"

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-22U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.110 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	4.33 cfs

Results

Depth	0.65 ft
Flow Area	0.6 ft ²
Wetted Perimeter	2.34 ft
Top Width	1.95 ft
Critical Depth	0.88 ft
Critical Slope	0.022060 ft/ft
Velocity	6.86 ft/s
Velocity	0.73 ft
Head	
Specific Energy	1.38 ft
Froude	2.12
Number	
Flow Type	Supercritical

Notes: Use Min. Depth = 1.0 ft; Minimum Freeboard = 0.35 ft.

Velocity > 5 fps: Use riprap D50 = 6"

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-23U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.190 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.12 cfs

Results

Depth	0.19 ft
Flow Area	3.4e-2 ft ²
Wetted Perimeter	0.52 ft
Top Width	0.37 ft
Critical Depth	0.25 ft
Critical Slope	0.041878 ft/ft
Velocity	3.51 ft/s
Velocity	0.19 ft
Head	
Specific Energy	0.38 ft
Froude	2.03
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.5 ft
Velocity < 5 fps

Minimum Freeboard = 0.31 ft
No riprap required

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-24U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.140 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.13 cfs

Results

Depth	0.20 ft
Flow Area	4.1e-2 ft ²
Wetted Perimeter	0.57 ft
Top Width	0.40 ft
Critical Depth	0.25 ft
Critical Slope	0.041435 ft/ft
Velocity	3.19 ft/s
Velocity	0.16 ft
Head	
Specific Energy	0.36 ft
Froude	1.77
Number	
Flow Type	Supercritical

Use Minimum Depth = 0 ft
Velocity < 5 fps

Minimum Freeboard = 0.31 ft
No riprap required

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-25U
Flow Element	Trapezoidal
	Channel
Method	Manning's
	Formula
Solve For	Channel
	Depth

Input Data

Mannings Coefficient	0.030
Slope	0.160 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.16 cfs

Results

Depth	0.21 ft
Flow Area	4.5e-2 ft ²
Wetted Perimeter	0.60 ft
Top Width	0.43 ft
Critical Depth	0.28 ft
Critical Slope	0.040303 ft/ft
Velocity	3.53 ft/s
Velocity	0.19 ft
Head	
Specific Energy	0.41 ft
Froude Number	1.91
Flow Type	Supercritical

Notes: Use Min. Depth = 0.58 ft: Minimum Freeboard = 0.37 ft.

Velocity < 5 fps: No riprap required

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-26U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.240 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.28 cfs

Results

Depth	0.24 ft
Flow Area	0.1 ft ²
Wetted Perimeter	0.69 ft
Top Width	0.49 ft
Critical Depth	0.34 ft
Critical Slope	0.037405 ft/ft
Velocity	4.73 ft/s
Velocity	0.35 ft
Head	
Specific Energy	0.59 ft
Froude	2.39
Number	
Flow Type	Supercritical

Notes: Use Min. Depth = 0.58 ft: Minimum Freeboard = 0.34 ft.

Velocity < 5 fps: No riprap required

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-27U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.130 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.50 ft
Discharge	0.32 cfs

Results

Depth	0.13 ft
Flow Area	0.1 ft ²
Wetted Perimeter	0.96 ft
Top Width	0.88 ft
Critical Depth	0.19 ft
Critical Slope	0.028939 ft/ft
Velocity	3.63 ft/s
Velocity	0.21 ft
Head	
Specific Energy	0.33 ft
Froude	2.03
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.5 ft
Velocity < 5 fps

Minimum Freeboard = 0.37 ft
No riprap required

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-27U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.300 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.50 ft
Discharge	0.32 cfs

Results

Depth	0.10 ft
Flow Area	0.1 ft ²
Wetted Perimeter	0.86 ft
Top Width	0.80 ft
Critical Depth	0.19 ft
Critical Slope	0.028939 ft/ft
Velocity	4.87 ft/s
Velocity	0.37 ft
Head	
Specific Energy	0.47 ft
Froude Number	3.00
Flow Type	Supercritical

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-28U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.140 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.11 cfs

Results

Depth	0.19 ft
Flow Area	3.6e-2 ft ²
Wetted Perimeter	0.54 ft
Top Width	0.38 ft
Critical Depth	0.24 ft
Critical Slope	0.042367 ft/ft
Velocity	3.06 ft/s
Velocity	0.15 ft
Head	
Specific Energy	0.34 ft
Froude	1.75
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.5 ft
Velocity < 5 fps

Minimum Freeboard = 0.31 ft
No riprap required

B.C.

7G-188

8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-29U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.080 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.27 cfs

Results

Depth	0.29 ft
Flow Area	0.1 ft ²
Wetted Perimeter	0.83 ft
Top Width	0.59 ft
Critical Depth	0.34 ft
Critical Slope	0.037586 ft/ft
Velocity	3.10 ft/s
Velocity	0.15 ft
Head	
Specific Energy	0.44 ft
Froude	1.42
Number	
Flow Type	Supercritical

Notes: Use Min. Depth = 0.67 ft: Minimum Freeboard = 0.38 ft.

Velocity < 5 fps: No riprap required

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-30U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.130 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.30 cfs

Results

Depth	0.28 ft
Flow Area	0.1 ft ²
Wetted Perimeter	0.79 ft
Top Width	0.56 ft
Critical Depth	0.35 ft
Critical Slope	0.037062 ft/ft
Velocity	3.82 ft/s
Velocity	0.23 ft
Head	
Specific Energy	0.51 ft
Froude	1.80
Number	
Flow Type	Supercritical

Notes: Use Min. Depth = 0.58 ft: Minimum Freeboard = 0.30 ft.

Velocity < 5 fps: No riprap required

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-31U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.120 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	0.00 ft
Discharge	2.47 cfs

Results

Depth	0.52 ft
Flow Area	0.4 ft ²
Wetted Perimeter	1.86 ft
Top Width	1.55 ft
Critical Depth	0.70 ft
Critical Slope	0.023808 ft/ft
Velocity	6.16 ft/s
Velocity	0.59 ft
Head	
Specific Energy	1.11 ft
Froude	2.13
Number	
Flow Type	Supercritical

Notes: Use Min. Depth = 1.0 ft: Minimum Freeboard = 0.48 ft.

Velocity = 6.16 fps: Use riprap D₅₀ = 5"

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-32U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.170 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.08 cfs

Results

Depth	0.16 ft
Flow Area	2.6e-2 ft ²
Wetted Perimeter	0.46 ft
Top Width	0.32 ft
Critical Depth	0.21 ft
Critical Slope	0.044207 ft/ft
Velocity	3.04 ft/s
Velocity	0.14 ft
Head	
Specific Energy	0.31 ft
Froude	1.88
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.5 ft
Velocity < 5 fps

Minimum Freeboard = 0.34 ft
No riprap required

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-33U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.180 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.20 cfs

Results

Depth	0.23 ft
Flow Area	0.1 ft ²
Wetted Perimeter	0.64 ft
Top Width	0.45 ft
Critical Depth	0.30 ft
Critical Slope	0.039121 ft/ft
Velocity	3.90 ft/s
Velocity	0.24 ft
Head	
Specific Energy	0.46 ft
Froude	2.05
Number	
Flow Type	Supercritical

Notes: Use Min. Depth = 0.58 ft: Minimum Freeboard = 0.35 ft.

Velocity < 5 fps: No riprap required

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-34U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.110 ft/ft 000
Left Side Slope	0.67 V : H
Right Side Slope	0.67 V : H
Bottom Width	1.00 ft
Discharge	1.66 cfs

Results

Depth	0.24 ft
Flow Area	0.3 ft ²
Wetted Perimeter	1.86 ft
Top Width	1.71 ft
Critical Depth	0.36 ft
Critical Slope	0.023221 ft/ft
Velocity	5.13 ft/s
Velocity	0.41 ft
Head	
Specific Energy	0.65 ft
Froude	2.08
Number	
Flow Type	Supercritical

Notes: Use Min. Depth = 0.58 ft: Minimum Freeboard = 0.34 ft.

Velocity = 5 fps: No riprap required

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-35U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.010 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.29 cfs

Results

Depth	0.45 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.27 ft
Top Width	0.89 ft
Critical Depth	0.35 ft
Critical Slope	0.03723 ft/ft 1
Velocity	1.45 ft/s
Velocity	0.03 ft
Head	
Specific Energy	0.48 ft
Froude Number	0.54
Flow Type	Subcritic al

Use Minimum Depth = 1.0 ft
Velocity < 5 fix

Minimum Freeboard = 0.55ft
No riprap required

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-36U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.080 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.03 cfs

Results

Depth	0.13 ft
Flow Area	1.7e-2 ft ²
Wetted Perimeter	0.37 ft
Top Width	0.26 ft
Critical Depth	0.14 ft
Critical Slope	0.050385 ft/ft
Velocity	1.79 ft/s
Velocity	0.05 ft
Head	
Specific Energy	0.18 ft
Froude	1.24
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.5 ft
 Velocity < 5 fps

Minimum Freeboard = 0.37 ft
 No riprap required

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-37U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.080000 ft/ft
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	1.25 cfs

Results

Depth	0.52 ft
Flow Area	0.3 ft ²
Wetted Perimeter	1.48 ft
Top Width	1.05 ft
Critical Depth	0.63 ft
Critical Slope	0.030641 ft/ft
Velocity	4.55 ft/s
Velocity	0.32 ft
Head	
Specific Energy	0.32 ft
Froude	1.57
Number	
Flow Type	Supercritical

Use Minimum Depth = 1.0 ft
Velocity < 5 fps

Minimum Freeboard = 0.30 ft
No riprap required

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-38U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.150 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	1.15 cfs

Results

Depth	0.45 ft
Flow Area	0.2 ft ²
Wetted Perimeter	1.28 ft
Top Width	0.90 ft
Critical Depth	0.61 ft
Critical Slope	0.030984 ft/ft
Velocity	5.64 ft/s
Velocity	0.50 ft
Head	
Specific Energy	0.95 ft
Froude	2.09
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.67 ft
Max Slope = 15%

Minimum Freeboard = 0.22 ft
Use D₅₀ = 3"

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-39U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.100 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.09 cfs

Results

Depth	0.19 ft
Flow Area	3.5e-2 ft ²
Wetted Perimeter	0.53 ft
Top Width	0.37 ft
Critical Depth	0.22 ft
Critical Slope	0.043518 ft/ft
Velocity	2.56 ft/s
Velocity	0.10 ft
Head	
Specific Energy	0.29 ft
Froude	1.48
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.5 ft
Velocity <5 fps

Minimum Freeboard = 0.34 ft
No riprap required

B.C.

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Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-40U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.090 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	2.41 cfs

Results

Depth	0.66 ft
Flow Area	0.4 ft ²
Wetted Perimeter	1.85 ft
Top Width	1.31 ft
Critical Depth	0.82 ft
Critical Slope	0.028073 ft/ft
Velocity	5.61 ft/s
Velocity	0.49 ft
Head	
Specific Energy	1.14 ft
Froude	1.73
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.75 ft
Velocity = 55.61 fps

Minimum Freeboard = 0.09 ft
Use D₅₀ = 3"

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-41U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.150 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	2.27 cfs

Results

Depth	0.58 ft
Flow Area	0.3 ft ²
Wetted Perimeter	1.65 ft
Top Width	1.17 ft
Critical Depth	0.80 ft
Critical Slope	0.028298 ft/ft
Velocity	6.69 ft/s
Velocity	0.70 ft
Head	
Specific Energy	1.28 ft
Froude	2.19
Number	
Flow Type	Supercritical

Use Minimum Depth = 1.0 ft
Velocity = 6.69 fps

Minimum Freeboard = 0.42 ft
Use D₅₀ = 4"

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-42U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.630 ft/ft 000
Left Side Slope	1.00 V : H
Right Side Slope	1.00 V : H
Bottom Width	0.00 ft
Discharge	0.04 cfs

Results

Depth	0.10 ft
Flow Area	9.6e-3 ft ²
Wetted Perimeter	0.28 ft
Top Width	0.20 ft
Critical Depth	0.16 ft
Critical Slope	0.048485 ft/ft
Velocity	4.17 ft/s
Velocity	0.27 ft
Head	
Specific Energy	0.37 ft
Froude	3.33
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.25 ft
Velocity < 5 fps

Minimum Freeboard = 0.15 ft
No riprap required

B.C.

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8/01/02

Worksheet

Worksheet for Trapezoidal Channel

Project Description

Worksheet	D-43U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.030
Slope	0.450 ft/ft 000
Left Side Slope	0.50 V : H
Right Side Slope	0.50 V : H
Bottom Width	0.00 ft
Discharge	0.64 cfs

Results

Depth	0.21 ft
Flow Area	0.1 ft ²
Wetted Perimeter	0.96 ft
Top Width	0.86 ft
Critical Depth	0.36 ft
Critical Slope	0.026861 ft/ft
Velocity	6.96 ft/s
Velocity	0.75 ft
Head	
Specific Energy	0.97 ft
Froude	3.75
Number	
Flow Type	Supercritical

Use Minimum Depth = 0.5 ft
Velocity = 6.96 fps

Minimum Freeboard = 0.29 ft
Use D₅₀ = 5"

B.C.

7G-203

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